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ADDIS ABABA SCIENCE AND TECHNOLOGY UNIVERSITY

COLLEGE OF ARCHITECTURE AND CIVIL ENGINEERING

Analysis of Facts and Figures in Construction Site Accidents in Ethiopia

By

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A Thesis Submitted to College of Architecture and Civil engineering in Partial Fulfillment of the Requirement for Degree of Master of Science in Civil Engineering (Construction Technology and Management)

Advisor

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APPROVAL PAGE

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Selam Kassahun, declare that this thesis is my own original work that has not been presented and will not be presented by me to any other University for similar or any other degree award.

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DEDICATION

I dedicated this piece of work to my beloved husband and my family.

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Abbreviations

CDM	Construction Design and Management
E.C	Ethiopian Calendar
EMR	Experience Modification Rate
FDRE	Federal democratic republic of Ethiopia
HEENT	Head, Eye, Ear, Nose and Throat
H&S	Health and Safety
HSE	Health and Safety Executive
ILO	International Labor Organization
OHSS	Occupational Health and Safety Standard
OSHA	Organizational Health and Safety Administration
OSH	Occupational Safety and Health
PPE	Personal Protective Equipment
WHS	World health and safety
WHO	World health organization

ABSTRACT

In construction industry, safety is even more critical than in other industries. Every nation must take construction health and safety quite seriously, because the accident and fatality (death) rates in this industry are among the highest in most countries around the world, including the developed nations.

Although construction industry in Ethiopia grows rapidly, safety culture in construction sites is very poor. The cost of construction site accident and lost work days also high due to the poor safety practices and the complexity of the construction industry itself. Most construction company do not provide safety equipment's for their workers due to that many workers suffer to site injuries. The three leading causes of injury from the finding were falling from height followed by falling an object and mishandling. As a result of these causes of injury abrasion, punctured and rupture were caused to the workers specially on upper and middle body parts. The fatality of the construction accident is higher in 2009 when comparing 2005 to 2008. Around 76% of these injuries happened to males workers and 24% to female workers.

The aim of this research is to analyze the accident figures in Ethiopian construction industry. The method of data collection is held through secondary data collection. Most of the data were obtained from Addis Ababa city labor and social affairs bureau and also surveying data in some Addis Ababa construction industry sites.

The research encompasses safety culture in Ethiopia's construction industry, cost of construction accident, causes and types of accident and reviewing empirical research in the literature review of this study and at last analyze accident figures in Ethiopia's construction industry.

Keywords:

Construction industry, Construction site accident, Causes of injury, Safety equipment, Accident figures, Ethiopia.

CHAPTER ONE
INTRODUCTION

1.1 Background

Construction industry is comparatively less organized and involves participation of major percentage of unskilled labor as compared to other industrial sectors. As a major employment generator in many parts of the world, construction is also a sector associated with a proportionately high number of work-related accidents and diseases (ILO-2009). Despite mechanization, the industry is still largely labor-intensive, while working environments are frequently changing and involve many different parties. Similarly it is of particular importance to the construction industry, where it is one of the major employers of the work force in Ethiopia. Statistics indicate that injuries and death due to construction related accidents are increasing.

According to Elsafty et al. (2012) estimates each year there are at least 60,000 fatal accidents on construction sites around the world. 64% in Asia and Pacific region, 17% in America, 10% in Africa and 9% in Europe. In many industrialized countries, as many as 25% to 40% of work-related deaths are occurred in construction sites, even though the sector employees only 6% to 10% of the workforce (ILO ITC, 2009). In some countries, it is estimated that 30% of construction workers suffer from back pains or other muscular disorders. Accidents are generally unavoidable in construction projects but the number and gravity of accidents can be reduced considerably if proper safety measures are taken beforehand.

Ethiopia is currently enjoying a relatively strong growth in construction activities so as striving hard to improve basic facilities by building schools, hospitals, housing complexes, shops, offices, highways, power plants, industries, bridges and other infrastructures as typical developing countries. There is unskilled labor force at cheap rate for construction activities, agriculture and small scale industries. Occupational hazards among these workers are high due to illiteracy, poverty, lack of proper training and information on dangers and risks at the workplace and other related factors. Such workers are known to face rapidly changing workplaces, a high degree of competition and bouts of unemployment. It is estimated that construction workers are three times more likely to be killed and twice as likely to be injured as workers in any other occupation (ILO, 2009). In developing countries the occupational health and safety hazards faced by construction workers are greater than those in industrialized countries. However, in African countries where traditional hazards have not been dealt with

adequately the introduction of new technologies, chemicals, and materials have led to new occupational and work-related diseases and hazards (Mesafint et al, 2008). Farris identified the possible safety and health hazards, sanitary conditions, and health promotion and accident prevention aspects of small scale enterprises in Ethiopia. According to his study, the prevalence of work related accident rate was 178 per 1000 workers per year in Ethiopia during 1995. Comparatively, little work has been carried out on construction health and safety issues in Ethiopia using media such as internet and journals survey.

The country's booming construction sector is attracting thousands of laborers (Plus News, 2010). Unfortunately, Ethiopia‘s construction industry suffers from poor safety and health conditions, even though; the constitution (1995) article 42/2 declared rights of labors to work in a healthy and safe work environment. The framework of the existing occupational safety and health conditions is fragmented and inadequately enforced, making construction sites more hazardous.

Globally, efforts to improve work place condition were put in place as early as 1945, but it was only that 1979 that WHO and ILO intensified their efforts. In 1996, the global strategy on occupational health for all was adopted. The strategy seeks improvement in occupational health and safety through the application of health measures in some countries and encourages others to take positive steps to make such trends possible (Glendo and Mckenna 1995).

The global strategy has 10 objectives: policies for health at work, healthy work environment, healthy work practices, occupational health services (including ergonomics, industrial hygiene, and safety, and not just medicine), support services, occupational health standards, human resource development, data information and awareness, strengthening of research, collaboration with other services. WHO has concentrated on the areas of evidence for policies, workers health promotion and protection and infrastructure and capacity building. It is also supporting the development of national action plans. Capacity building is vital, involving GOHNET, the global occupational health network: details were available at the meeting. The third area concerns the health promotion and protection of workers, including Healthy Cities and the informal sector. Africa is the first continent for this work.(WHO-ILO Joint Effort on Occupational Health and Safety in Africa, 200)

Since 2000, WHO and ILO have pursued collaboration and cooperation in occupational health with various institutions in Africa Region to identify and address the health and safety needs of workers. In 2003, the regional director of WHO and ILO signed a statement of intent for the collaboration of occupational health and safety in Africa.

In Ethiopia, the key legislation of workers health and safety is order on labor proclamation No. 377/2003 which focuses on employment relations, employer worker relations and obligations, termination and compensations of workers, hygiene and work safety norms at work place, such as industrial accident and occupational disease, control of health service, promotion of health and safety amongst workers, the FDRE labor proclamation No. 377/2003 has twelve parts. The part seven of this proclamation talks about occupational safety, health and working environment. This order has three chapters,

-The first chapter includes the obligation of employers and obligation of workers

-The second chapter talks about occupational injuries such as occupational accident, occupational disease, degree of disablement, temporary and permanent disablements

-The third is benefit in the case of employment injury such as medical benefit and cash benefit.

Safety Guidelines in Construction Industry

A safety guideline may be defined as an outline of the safety policies, practices, and procedures Reimer (1999), and should provide actions that must be taken to regulate the factors that cause accidents, and systematically integrate them into the day-to-day management and operation of the company. A safety policy is a more detailed document containing the specific plans and procedures, and should include, but not limited to, the following in the world:

1. General safety policies – statements about management's commitment to safety.
2. Hazard assessment procedures - checklists for assessing hazards on a job site.
3. Safe work practices and procedures - instructions on how to do specific jobs safely; ways of controlling hazards and doing jobs with minimum risk to people and property.
4. Personal protective equipment (PPE) information - policy statements and instructions for use of personal protective equipment.
5. Maintenance policies and information - policy statements regarding maintenance and care of equipment.
6. Training policies - policy statements regarding training requirements e.g. new employee safety orientation, job-specific or specialized training, safety training for supervisors and managers etc.
7. Inspection policies - forms for regular inspection of the job-site for unsafe conditions/acts; observations should be documented and corrections made.
8. Incident investigation policies and information - policies and forms for determining the cause and prevention of re-occurrence of specific incidents.
9. Emergency provisions - regulations regarding first aid, reporting forms; information to be used in emergency situations.

Workers have a duty to take reasonable care for their own health and safety and that they do not adversely affect the health and safety of other persons. So every worker must use the Personal protective equipment (PPE) in the site work. These equipment's are: Protective clothing, Safety foot wear(safety shoes), Safety helmet, Eye face protection and Hearing protection.

Safety tips in construction sites

In building construction sites false work, scaffolds and ladders are important things which are temporary structures workers use during construction to facilitate works specially at height and safe guard when used properly. fencing a temporary structure for both buildings and roads but it protects from the safety.

Falsework

The falsework should erected in accordance with the design and securely erected. Checking whether the struts of the falsework is necessary . the props should erected vertically and arranged at a suitable distance in a row

Scaffold

Workers should not use scaffolds unless they have been erected by trained workmen and under the supervision of a competent person and should not have to work on a scaffold unless it has been provided with a suitable working platform

Fencing

Workers should not work in a dangerous place unless its floor edges and openings have been installed with secure fencing. If there is any dangerous places that have not been installed with fencing or the fencing has been damaged, it must reinstall or repair the fencing.

Ladder

Use a ladder which is of good construction, sound material and adequate strength and Examine the ladder before using it and inspect it at regular intervals. If work is carried out 2 meters or more above the floor, use a suitable working platform.

Personal Safety and Hygiene

Eye Protection

A wise worker will certainly take good care of his eyesight. A small fragment may cause serious consequences if it enters one's eyes. When there is a risk of eye injury, such as in concrete breaking or using abrasive wheels, workers should wear suitable eye protectors.

Noise

workers should have to wear ear protectors in areas with high noise levels. They have Properly wear ear protectors according to the manufacturer's instructions and do not reuse disposable ear plugs.

Personal Protective Equipment

For own safety and interest, workers should have to use the personal protective equipment provided by their employer.

- Wear gloves when handling or contacting chemicals.
- Remember to wear a mask when working in a dusty environment.
- Wear eye and ear protectors whenever necessary.
- Wear a safety harness and secure it to a safe anchorage point when working at height. A bamboo scaffold is not a safe anchorage point, so do not fasten the safety harness to it.
- Wear safety shoes to prevent foot injury.
- Consult your supervisor if in doubt.

Minimizing risk associated with falling objects

Falling objects in construction are such as construction tools, blocks, stones, bolts and nuts and other accessories. Therefore to prevent injury from the falling objects Providing a secure, barrier, Providing a safe means of raising and lowering objects, Providing an exclusion zone persons are prohibited from entering.

Minimizing risk associated with falling from height

providing a fall arrest system is important in order to minimize injury falling from height. Examples; Providing temporary work platforms, Providing training in relation to the risks involved in working at the workplace and Providing safe work procedures, safe sequencing of work, safe use of ladders, permit systems and appropriate signs.

Fall prevention device includes: a secure fence, edge protection, working platforms and covers.

1.2 Statement of the Problem

According to the assessment of Ethiopian construction management instate officers,2016 construction industry accidents in Ethiopia have not been well recorded and no sufficient studies being carried out. Nevertheless, it is reported that many people lost their lives on construction sites and many more seriously injured. Not only are construction workers who suffer injuries and death but also the public who are not employed in the industry. Besides human tragedies, accidents could incur substantial economic loss to the industry due to the fact it could also cause: Damage to plant and equipment, Damage to work already completed, Loss

of productive work time while debris is cleared and damaged work rebuilt, Increased insurance premiums, and Loss of confidence and reputation.

1.3 Significance of the study

In Ethiopia there are few studies on identifying accidents and health and safety on construction accidents but no statistical data of accidents and injuries in the industry are investigated before. Therefore it is important to investigate the statistical data and gage future accidents in Ethiopia in order to substantiate the trend and make informed decisions by insurance company and concerned government bodies.

1.4 Aim

To analyze accidents statistics within the construction industry and to show whether the economic climate has an effect on the rate of accidents in the industry.

1.5 Objective of the study

The purpose of this study is to provide overview of the history of accidents in the construction industry in Ethiopia

Specific Objectives

- To develop baseline data on accident rate of Ethiopian construction industry.
- To show the trends that has the highest accident rate by analyzing the ratio of accidents to employees.
- To examine the cost implication of construction site accidents.

1.6 Scope and Limitations

This study encompasses the general health and safety aspects of workers in Ethiopian construction industry. Specially it focuses on the figures of the accidents, death and injury trend and number and also shows the cost of construction site accidents. However, there are limitations of real accident figures as most construction companies do not report their workers accident and at times unwilling to provide data for research purposes given that central statistical agency also doesn't carry out survey on construction accidents.

1.7 Structure of the paper

This research paper has five chapters chapter one has the introduction part of the document including back ground, aim and objective, statement of the problem, scope and limitation and the structure. Chapter two includes the literature reviews chapter three with methodology, chapter four results and discussions, Chapter five conclusion and recommendations. Finally Reference and appendix also included in the paper.

1.8 Definition of key Terms

Health

Health is the general condition of a person in mind, body and spirit, usually meaning to be free from illness, injury or pain. The World Health Organization (WHO) defined health in its broader sense in 1946 as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity" (WHO, 2006). In this study health means being free from illness, injury or pain which can be caused by construction activities.

Safety

Safety is related to external threats, and the perception of being sheltered from threats. According to the business Dictionary, safety is defined as a relative freedom from danger, risk, or threat of harm, injury, or loss of personnel and/or property, whether caused deliberately or by accident. Safety can also be defined as the control of recognized hazards to achieve an acceptable level of risk. In this study, safety means freedom from danger, harm, and injury to the person involved in construction activities.

Accident and Injury

The terms accident and injury refer to separate phenomena, mutually interrelated as cause and effect (exposure and outcome) (Andersson, 1999). The terms 'accident' and 'injury' are hereby used in accordance with the definition adopted at the first World Conference on Accident and Injury Prevention (WHO, 1989); that is, an accident is an unintentional event which results or could result in an injury, whereas injury is a collective term for health outcomes from traumatic events (Andersson, 1999). Rejda (1992) defined an accident as a "sudden, unforeseen and unintentional" event, which may result in physical harm to a person and/or damage to a property. The use of the term 'accident' in this thesis is based on an event which cause physical harm or damage to the body resulting from an exchange, usually acute, of mechanical, chemical,

CHAPTER TWO
REVIEW OF LITERATURES

2.1 Health and Safety in Construction Industry

The term safety generally applies to the protection from risk of injury and from avoidable accidents were as the term health refers to the well-being from the immediate and long-term effects of exposure to unhealthy working condition.

Health and safety are aspects of employee , welfare which have been separately identified as being significant areas of welfare provision for sometimes.

Occupational injuries pose a major public health and developmental problem, which results in a serious health, social and economic consequences on workers and their employers.

In accordance with labor proclamation, every employee has the right to enjoy suitable measures of protection and safety and hygiene at work as the employer is required to take all necessary measures to safeguard the health and safety of workers.

Safety and Health Regulations, WHS

This sub topic is a review from a model world health and safety book, 2016 which contains the general workplace management and general working environment.

General Workplace Management

The employer must ensure that information, training and instruction provided to a worker is suitable and adequate having regard to:

a. the nature of the work carried out by the worker; and

b. the nature of the risks associated with the work at the time the information, training or instruction is provided; and

c. the control measures implemented

The person must ensure, so far as is reasonably practicable, that the information, training and instruction provided under this regulation is provided in a way that is readily understandable by any person to whom it is provided

General Working Environment

1. Duty in relation to general workplace facilities

A person conducting a business or undertaking at a workplace must ensure, so far as is reasonably practicable, the following: the layout of the workplace allows, and the workplace is maintained so as to allow, for persons to enter and exit and to move about work in relation to or near essential services does not give rise to a risk to the health and safety of persons at the workplace.

2. Duty to provide and maintain adequate and accessible facilities

A person conducting a business or undertaking at a workplace must ensure, so far as is reasonably practicable, the provision of adequate facilities for workers, including toilets, drinking water, washing facilities and eating facilities.

maintained so as to be:

a. in good working order; and
b. clean, safe and accessible

must ensure: the provision of first aid equipment for the workplace; that each worker at the workplace has access to the equipment; and access to facilities for the administration of first aid.

3. Duty to prepare, maintain and implement emergency plan

(1) A person conducting a business or undertaking at a workplace must ensure that an emergency plan is prepared for the workplace, that provides for the following:

(a)emergency procedures, including: an effective response to an emergency; evacuation procedures; notifying emergency service organisations at the earliest opportunity; an medical treatment and assistance; and effective communication between the person authorised by the person conducting the business or undertaking to coordinate the emergency response and all persons at the workplace;

This regulation applies if personal protective equipment is to be used to minimise a risk to health and safety in relation to work at a workplace.

(2)The person conducting a business or undertaking who directs the carrying out of work must provide the personal protective equipment to workers at the workplace, unless the personal protective equipment has been provided by another person conducting a business or undertaking.

(a) Selected to minimise risk to health and safety, including by ensuring that the equipment is:

(i) suitable having regard to the nature of the work and any hazard associated with the work;

(ii) a suitable size and fit and reasonably comfortable for the worker who is to use or wear it; a

(b) maintained, repaired or replaced so that it continues to minimise risk to the worker who uses it, including by ensuring that the equipment is:

(i) clean and hygienic; and

(ii) in good working order; and

(c) used or worn by the worker, so far as is reasonably practicable.

Duties of worker

(1) This regulation applies if a person conducting a business or undertaking provides a worker with personal protective equipment.

(2) The worker must, so far as the worker is reasonably able, use or wear the equipment in accordance with any information, training or reasonable instruction by the person conducting the business or undertaking the worker must not intentionally misuse or damage the equipment

The above general work place management were reviewed from WHS regulations ,2016

Health and safety rules in Ethiopia

The status of occupational injuries in workplace is ill defined in Ethiopia. Some studies indicated that occupational injury due to an unsafe working environment is increasing.

FDRE labor proclamation No. 377/2003 clause 92 states the following workers and employers obligations.

Obligations of an Employer

An employer shall take the necessary measure to safeguard adequately the health and safety of the workers; he shall in particular:

1/ comply with the occupational health and safety requirements provided for in this Proclamation;

2/ take appropriate steps to ensure that workers are properly instructed and notified concerning the hazards of their respective occupations and the precautions necessary to avoid accident and injury to health; ensure that directives are given and also assign safety officer; establish an occupational, safety and health committee of which the committee's establishment, shall be determined by a directive issued by the Minister;

3/ provide workers with personal protective equipment, clothing and materials instruct them of their use;

4/ register employment accident and occupational diseases and notify the labor inspection of same;

5/ arrange; according to the nature of the work, at his own expenses for the medical examination of newly recruited workers and for those workers engaged in hazardous work, as may be necessary.

6/ ensure that the work place and premises do not cause danger to the health and safety of the workers;

7/ take appropriate pre-executions to insure that all the processes of work shall not be a source or cause of physical, chemical, biological, ergonomically and psychological hazards to the health and safety of the workers;

8/ obey the directives issued by the appropriate authority in accordance with this Proclamation.

Obligations of a worker

A worker shall:

1/ co-operate with the employer in the formulation and implementation of work rules to safeguard the workers' health and safety.

2/ inform forthwith to the employer any defect related to the appliances used and injury to health and safety of the workers that he discovers in the undertaking.

3/ report to the employer any situation which he may have reason to believe could present a hazard and which he cannot remedy on his own any accident or injury to health which arises in the course of or in connection with work.

4/ make proper use of all safeguards, safety devices and other appliance furnished for the protection of his health or safety and for the protection of the health and safety of others.

5/ obey all health and safety instructions issued by the employer or issued by the competent authority.

2.2 Accidents in the Construction Industry

An accident can be defined as an unplanned, undesirable, unexpected, and uncontrolled avoidable action by personnel or any failure of equipment, tools or other devices that interrupts production and has the potential of injuring people or damaging property (Latief and Suraji, 2002).

An accident defined by the Health and Safety executive, 2010 also as an unplanned event that results in injury or ill health of people, or damage or loss to property, plant, material or the environment or a loss of a business opportunity.

Accidents in construction projects in many countries are of important issue to handle. The phenomena makes the construction industry has a big image of risky place of accidents

(Sawachaetal., 1999; Shi, 2009). The nature of construction project itself has potential hazards of accidents since its uniqueness, open space, exposure to weather, involving many unskilled labors, tight schedule of short targeted project duration, workers turn over and working at height, confined space and psychologically and physically vulnerably working environment (Imriyas et al., 2007)

Common Types of Construction Accident

Some of the most common types of construction accidents include construction site falls, crane accidents, scaffolding accidents, workers being run-over by operating equipment, electrical accidents, trench collapses, fires and explosions, and welding accidents.

1. Construction Site Falls

Construction site falls include (Imriyas et al, 2007) roof related falls, crane falls, scaffolding falls, elevator shaft falls, falls resulting from holes in flooring, and falling objects.

Proper protection equipment and safety precautions are necessary to protect the lives of workers.

2. Crane Accidents

Crane accident deaths can arise from a number of factors, including lightning, high winds, defective cranes, Falls, electrocution, and other hazards associated with construction at heights. Many crane accidents can be avoided with proper training and safety procedures.

3. Scaffolding Accidents

Scaffolding is a temporary structure used to support people and material in the construction or repair of buildings and other large structures. It is estimated that 65 percent of the construction industry works on scaffolds frequently. The use of scaffolding is necessary in the construction industry. Some of the most dramatic structures that have been built by humans relied on scaffolds to get the job done.

Many of construction workers injured in scaffold accidents connected the event with planking, supports giving way, the employee slipping and being struck by a falling object.

Most scaffolding accidents can be avoided through proper training and preventative measures.

4. Run Over by Operating Equipment

The construction site is an extremely busy work environment with movement of workers and vehicles. There are circumstances when construction workers are run-over or injured by operating equipment. Accidents such as this can occur at any work site, but risks are increased when working on highways or near busy roads with heavy equipment. In these environments workers must be vigilant and meticulous when practicing safety standards.

5. Electrical Accidents on Construction Sites

It is estimated by OSHA, 2012 that nearly 350 construction workers die every year in the world from electrical accidents. A few causes of these fatalities include; electric shock, electrocutions, steam accidents, and power line contact.

The risks of these hazards are heightened for workers who perform their jobs on scaffolding or in cranes near overhead power lines.

6. Trench Collapses

The building of trenches is necessary for many construction tasks. When trenches are constructed they must have safeguards in place to protect workers inside the trench from a collapse. When a trench collapses workers may easily become crushed under the weight of heavy soil from above.

It is absolutely imperative that appropriate safety measures are taken during the building process to ensure the safety of all workers involved.

7. Fires and Explosions in Construction Site

The OSHA, 2012 has determined that workplace fires and explosions kill 200 and injure more than 5,000 workers each year.

A fire plan should exist at construction sites so that workers can be safely evacuated in the event of fires and explosions.

8. Unsafe/Dangerous Construction Equipment Accidents

The size and power of the machines and equipment used in the construction industry can be responsible for some of the most grievous injuries if not used carefully and professionally. Construction equipment, like every other type of machinery, can experience mishap and failure particularly if it is overused or improperly maintained. Everything from cranes to forklifts to scaffolding and ladders can cause potentially fatal accidents with the failure of a manufacturer to Provide safe equipment or with the negligence of those responsible for repair and maintenance.

9. Structure Failure on Construction Site

A structure failure takes place when a building or other structure breaks in such a way that it cannot carry as great a load as it could before failure. Structure failures can be catastrophic and result in major injury and loss of life. The designer and the contractor should be responsible for the works they produce.

2.3 Accident Causation Model

In order to have a meaningful analysis of the accident data, there is a need for a fundamental accident causation model that highlights the main accident events and main types of causal factors. Accident causation models are originally developed in order to assist people who had to investigate accidents, so that such accidents could be investigated effectively. Knowing how accidents are caused is also useful in a proactive sense in order to identify what types of failures or errors generally cause accidents, and so action can be taken to address these failures before they have the chance to occur.

There are several major theories concerning accident causation, each of which has some explanatory and predictive value.

Table 2: 1 Accident causation model causes and preventions (Abdelhamid and Everett, 2000).

Accident Causation Model	**Causes of Accident**	**Prevention**
Accident Proneness Model	Result of pure chance, blamed on employee rather than work process and poor management	Avoiding those with undesirable traits or by trying to modify through training and counseling
Domino Theory	Consist of five dominoes namely ancestry and social environment, fault of a person, unsafe acts and condition, accident, and injury	The management should provide workers with safety facilities to prevent the workers from hazardous environment.
Human-Factor Theory	An error by an individual due to overload, incompatibility and improper activities. Design of workplace and tasks that do not consider worker (human) limitation also take part as the reason why accident happened	Create a better design workplace, tasks, and tools that suitable with human limitation.
System Theory	Person(host), machine (agency), and environment.	The rules and procedures which are laid down by others to try to govern that use, and the organizations which manage the system.
Multiple Causation Model	Root causes of accident normally relate to the management system such as management policy, procedure, supervision, effectiveness, training,	Supervisory-responsibility, safety training and pre job planning

2.4 Health and Safety and the Employment Trend

Considering the importance of health and safety of construction workers in the industry, different countries have designed their own norms, which fit their specific objectives. The International Labor Organization (ILO) provides specific guidelines on health and safety in construction activities.

The general objectives of health and safety norms/codes in any country construction industry according to ILO 2009 can be summarized as:

- To help prevent accidents and harmful effects on the health of those employed in construction industry.
- To provide guidelines in the appropriate deign, selection, installation and safe operation of equipment, and process related to civil engineering work.
- To provide guidance in establishing administrative, legal and educational frameworks within which preventive and remedial measures can be implemented

Small and medium-scale industries employed about 80% of the workforce and contribute over 90% of all industries in developing countries. Workers in these industries are at greater risk of work-related injuries, chronic illness, stress, and disability or death because of low educational and literacy rates, unfamiliarity with work process and exposures, and inadequate training (Faris, 1998; and Park, 2001).

According to Ministry of Health Department of Environmental Health, 1996 among 16,610 large-scale industrial workers in Addis Ababa, a prevalence rate of 723 injuries per 1000 exposed workers was observed and also according to ministry of labor and social affairs in Ethiopia in all over Ethiopia, millions of daily laborers work in big constructions in unsafe working environment and without supportive and protective equipment. They do not have sufficient protective caps, hand gloves, eye glasses, working clothes, shoes and so on. They work on high rise buildings standing on old and inclined wooden scaffolds and ladders, they even transport heavy construction materials like concrete and blocks on the improperly installed scaffolds. Moreover, the constructions do not have safety nets, restraint and fall arrest systems. As a result, a dozen of daily laborers get different serious injuries. Many, in fact, lose their life. Sohail (1999), described that Construction and operation in developing countries is particularly dangerous, and a cursory inspection of any job site will reveal many health and safety hazards.

In the case of Ethiopia, the Ministry of Labor and Social Affairs is authorized by law for the full responsibility of consulting, monitoring and other works related to occupational health and safety topics. Even though it is difficult to obtain accurate statistics since many accidents go ***undetected*** and ***unreported***, the number of construction accidents occurring in Ethiopia, is increasing from time to time. In constructions under-taken in Ethiopia, the construction contract agreement (i.e.) General Conditions of Contract (clause 21 - 25) and FIDIC (clause 19 - 25) states the responsibilities of the involved parties. These are like provisions of ***insurance***, taking other ***safety measures***, etc.

Trend in the frequency of casualty

The frequency is represented by the number of workers killed or injured by accidents per one million working hours. It is determined by dividing number of casualty multiplied by one million in accident that have occurred during the statistical period of time by the total number of working hours of all workers exposed to danger during the same period.

The figure bellow, figure 2.1 represent frequency of casualty in Japan construction industry 1970 to 2006.

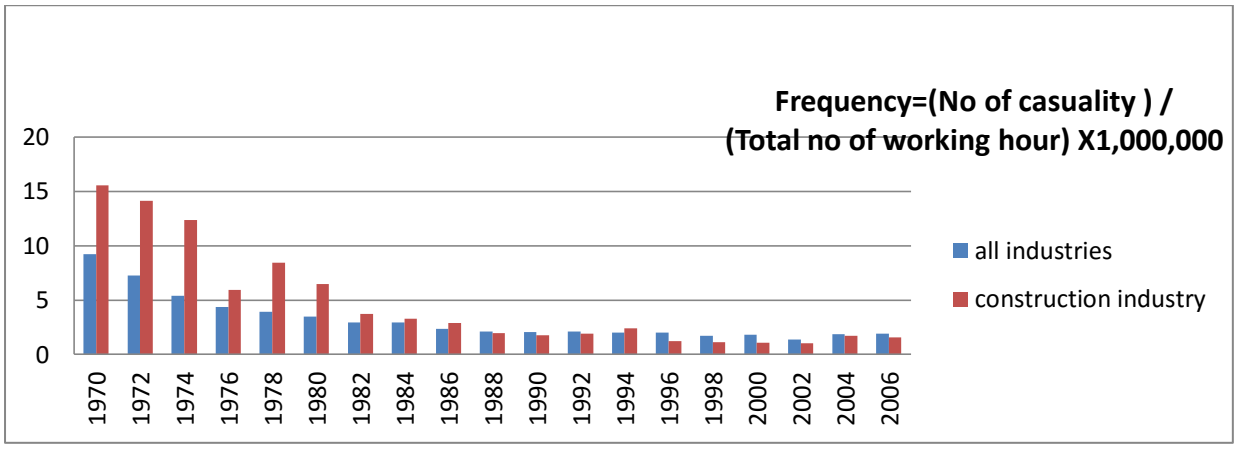

Figure 2: 1 Trends in the Frequency of Casualty Source: Report on Fatal Accidents" by the Ministry of Health, Labor and Welfare Japan, 2007

2.5 Safety Culture in the Construction Industry

Cooper (2000) defined safety culture as a sub-facet of organizational culture, which is thought to affect member's attitudes and behavior in relation to an organization's ongoing health and safety performance.

Whereas Cox and Cox (1991) (in industrial gases, European) defined safety culture as one which reflects the attitudes, beliefs, perceptions, and values that employees share in relation to safety.

A definition of safety culture adopted by many researchers is: the product of individual and group values, attitudes, perceptions, competencies and patterns of behavior that determine the commitment to, and the style and proficiency of an organization's health and safety.

Glendon and McKenna (1995) stated that effective safety management is both functional (involving management control, monitoring, executive and communication subsystems) and human (involving leadership, political and safety culture sub-systems paramount to safety culture). In this approach, safety is looked into from the culture point of view of shared characteristics of a group dynamic relating to system (e.g. group, community, race, nation, religion) which include beliefs, values, attitudes, opinions and motivations.

Building a safety culture on so many diversities is not an easy task. But it had been proven that organizations with good safety cultures have employees with positive patterns of attitudes towards safety practice. These organizations have mechanisms in place to gather safety-related information, measure safety performance and bring people together to learn how to work more safely. Ostrom et al. (1993) looked at the employees' perceptions of safety culture as follows:

- Management attitudes towards safety;
- Perceived level of risk;
- Effects of work place;
- Management actions towards safety;
- Status of safety adviser and safety committee;
- Importance of health and safety training; and
- Social status of safety and promotion.

Creating a culture of safety means that the employees are constantly aware of hazards in the workplace, including the ones that they create themselves. It becomes second nature to the employees to take steps to improve safety. The responsibility is on everyone, not just the management. However, this is a long process to get to that point (Dilley and Kleiner, 1996).

Glendon and McKenna (1995) also identified four critical indicators of safety culture. They are:

- Effective communication, it leads to commonly understood goals and means to achieve them at all levels.
- Good organizational learning, whereby organizations are able to identify and respond appropriately to changes.
- Organizational focus upon health and safety, how much time and attention is essentially paid to health and safety.
- External factors, including the financial health of the organization, the prevailing economic climate and impact of regulation and how well these are managed.

Concept of Safety Culture in Construction Industry

Today, the changes in safety management have opened a new outlook to wear safety. It is no longer being treated as secondary in the business context rather it is treated as a culture. More emphasis is being put on ensuring everyone understand the importance of safety and changing the attitudes and behavior is the hard task. Safety is not only the manager's responsibility but everyone must play his responsibility (Stewart, 2002).

For a long time, the construction industry has been labeled with a poor occupational safety and health culture. Efforts to enhance occupational safety and health performance will not be effective until the occupational safety and health culture is improved (Misnan et al, 2006). As the result, there is a need for a major paradigm shift regarding attitudes on occupational safety and health in construction sites. Widening the understanding of behavior increases insight into possible targets for improvements, for example better planning, more effective job design, or more.

Safety Culture in Ethiopian Construction Industry

Safety culture in Ethiopian construction industry according some studies is very week and also from observation in most of the construction sites the laborers work with- out personal protective equipment even when they are at high rise building, working at hazardous places and also there is no regular training on health and safety for the employees.

Some of the Problems inherent to safety culture in Ethiopian construction industry according to interview to some company’s employees have been identified as follows:

1. Manager do not encourage reporting of incidents and errors using incentive and punishment schemes, but this change is likely to be short-lived.

2. Supervisors do not provides constant encouragement to do jobs safely
3. Workloads are not well managed and reasonable, there are no enough workers to carry out the required work safely
4. There is no good communication at sites about health and safety issues which could affect workers
5. There is no adequate training to the workforce to exceed safety standards
6. There is pressure to put production before safety

Layers of Safety Culture

Based on Schein's model, safety culture is also considered to have three layers:

The deepest layer (basic assumptions), an intermediate layer (beliefs and espoused values), and the surface layer (behaviors and artifacts).

Clarke (2000) provides examples of safety-related basic assumptions, beliefs and espoused values, and behaviors and artifacts.

Aspects of organizational safety culture

1. Surface level (norms and artifacts)

Safety policy document, Safety information system, safety rules and procedures, safety training, quality and maintenance of equipment, accident reporting, near miss incident reporting, safety representative and committees, managers actions (setting an example on safety, encouraging safety suggestions, consistency between policy and practice) and supervisors action (e.g. safety discipline, elevating safety concerns to management)

2. Intermediate Level (Beliefs and Values)

Managers attitudes(e.g. safety vs. production priority, blaming workers for accidents), supervisors' attitudes(e.g. supervisors fairness in dealing with safety complaints), workers safety attitudes, personal beliefs about risk and safety, personal involvement, individual responsibility, evaluation of safety measures and evaluation of work environment

3. Deepest Level (Core Assumptions)

Understanding that safety is the overriding priority

Stages in the Development of a Safety Culture

Safety culture in any occupation is very important but it cannot assure rapidly but gradually it can improve working safety culture. As any industry the construction industry needs its own developmental safety culture stage. The following is the three stages in developing safety culture;

Stage 1

Safety is seen as an external requirement imposed by government and regulatory agencies. It is not seen as something that will enhance the business or operation of the organization and also safety is seen as a technical issue and there is little awareness of the behavioral or attitudinal aspects of safety. The focus is on complying with rules and regulations.

Stage 2

Safety is seen as an important organizational goal, irrespective of externally imposed requirements. The safety management system generally concentrates on technical and procedural controls, although there is an emerging understanding of the importance of behavioral and attitudinal aspects of safety. Targets and goals are specified. However, it is common for the safety performance of organizations to improve rapidly and then to plateau.

Stage 3; the concept of continuous improvement of safety has been adopted.

There is a strong emphasis on safety communication, training, managerial behavior and improving safety system effectiveness. The impact on safety of cultural aspects of the organization is well understood.

Hudson (2007) defines five levels in progressively developing a safety culture namely,

1. Pathological; who cares about safety as long as we are not caught?
2. Reactive; Safety is important: we do a lot every time we have an accident.
3. Calculative; we have systems in place to manage all hazards.
4. Proactive; we try to anticipate safety problems before they arise.
5. Generative; H&S is how we do business around here.

An organization moving from a pathological safety culture towards a generative safety culture:

- is increasingly informed about H&S, and
- shows increasing levels of internal trust and accountability about H&S.

There is considerable evidence to indicate that the majority of organizations, particularly large and complex ones, do not develop a single uniform culture of safety. When two groups (for example, managers and workers):

- Wrongly perceive agreement between their own safety values, beliefs or attitudes and the safety values, beliefs or attitudes of the other group
- Hold negative stereotypes about each other's' safety values, beliefs or attitudes, and
- Have inaccurate perceptions of the others' safety values, beliefs or attitudes (Lingard & Blismas, 2006).

Figure 2.2 bellow depicts these misperceptions.

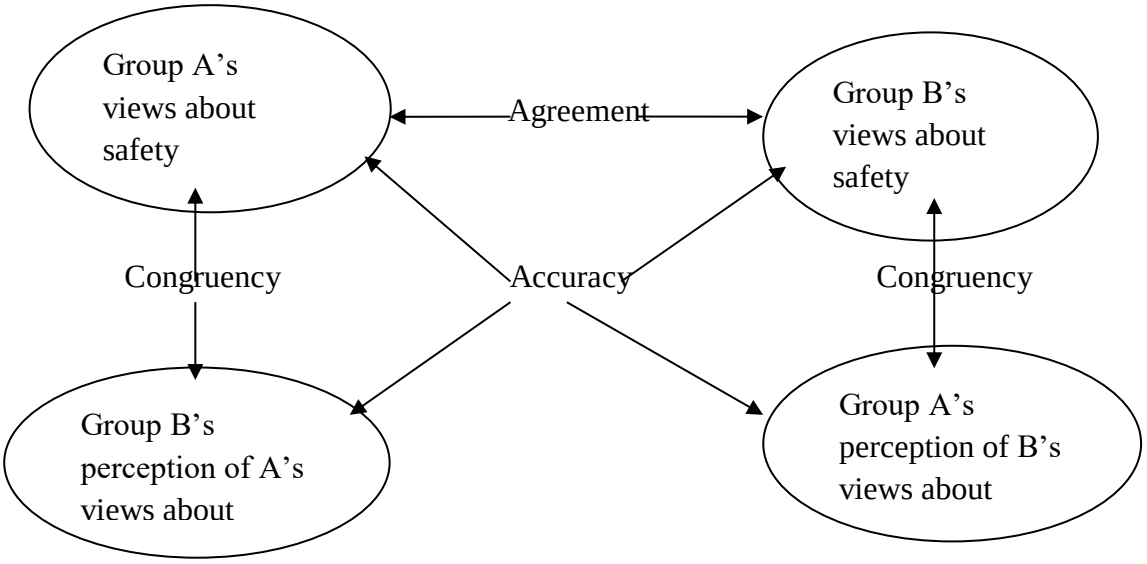

Figure 2: 2 Agreement, congruency and accuracy in understanding different groups H&S perceptions (Lingard and Blismas, 2006)

Characteristics of an Effective Safety Culture

According to Reason (1997), a safety culture is characterized by a sense of 'chronic unease' – that is, 'not forgetting to be afraid' – and maintaining an awareness and vigilance about potential health and safety hazards. Reason proposed that an effective safety culture displays five characteristics.

1. Has a safety information system that collects, analyses and disseminates information from accidents, near misses and active safety monitoring systems.

2. Has a reporting culture in which people feel able to report errors, mistakes, violations, and safety problems.

3. Has a culture of trust in which people are encouraged to provide safety information but in which a clear line is drawn between acceptable and unacceptable behavior.

4. is flexible and characterized by an ability to change in response to changes in a dynamic and demanding task environment.

5. is willing and able to analyze the performance of its safety system and make improvements to the system when required.

Jeffcott et al. (2006) also identified four components of a positive safety culture.

1. Flexibility

Flexibility ensures that norms and rules allow for a flexible approach, expertise is recognized, and decision making is decentralized. 'Frontline' knowledge and expertise is valued and used, especially in abnormal situations, to inform appropriate protection decisions.

2. Commitment

Management commitment to safety concerns the extent to which top management considers safety as the core value of the organization. Commitment is reflected in top management's enduring and positive attitude toward safety, which includes:

• Consistently emphasizing the importance of safety

• prioritizing safety over production in all situations (even in adverse events)

• providing adequate resources to support the implementation of safety activities

• Actively promoting safety across all levels within the organization.

3. Learning

Learning concerns aspects such as ongoing reflection on practice, nourishing reporting cultures, and learning from mistakes and failures.

Organizations characterized by learning:

• are highly committed to gathering and analyzing safety related information

• disseminate safety related information to the whole organization

• are sensitive to vigilance and expertise among frontline staff in identifying and responding to errors.

4. Trust

Trust concerns individuals' attitudes and expectations about the organizational systems where they are embedded. Trust is important to safety culture because it affects safety related matters such as communication, collaboration, information sharing, incidents/near miss reporting. A positive safety culture may also support, encourage, and appropriately reward trusting behaviors and relationships.

Safety Climate Component in Construction Industry

Zohar, 1980 defined safety climate as a ‘’summary of moral perceptions that employees share about their work environment’’. It refers shared perceptions among a relatively homogenous group. It is important to recognize that most efforts at measurement, typically through workplace surveys, are assessing climate. Safety climate data can tell us something about the underlying culture, particularly where gaps in perceptions exist within an organization.

The safety climate components in any organization including construction industry is comprised of organizational commitment, health and safety oriented behaviors, health and safety trust, usability of trust, engagement in health and safety, peer group attitude, resources for health and safety and accident and near miss reporting.

The following table, table 2.2 shows the safety climate components and their related themes.

Table 2: 2 Safety climate components and related theme (Health and Safety Executive, 2012)

1.Organizational Commitment	
Productivity vs. Safety	Management should prioritize health and safety and provide support to workers where conflicting pressures may arise.
Visibility and Approachability	Management should be frequently visible on site and demonstrate their commitment to safety, leading by example or questioning unsafe behaviors. They should be approachable so that workers feel comfortable raising safety issues without worrying about being criticized.
2. Health and Safety Oriented Behaviors	
Making safety Personal	Management should use campaigns and training courses that are relevant and appropriate to workers
Health and Safety Campaigns	Management use credible campaigns to enhance workers' commitment to healthy and safe behaviors, e.g. safety weeks.
Safety observations	Management should maintain a focus on working to safe procedures onsite, e.g. by using observation cards and regular inspections/site visits.
3. Health and Safety Trust	
Valuing the Workforce	Management should demonstrate that workers contributions through work and ideas are highly valued.

Reward and Recognition	Management should use incentive methods to recognize and reward their workers' contributions to health and safety, e.g. reporting incidents and near misses or making suggestions.
4. Usability of Procedures	
Development of Risk Assessments as 'live' Documents	Management should ensure risk assessment documentation is subject to ongoing review and revision and is accessible to workers.
Training	Management should use various types of training to ensure employees 'understanding of risk assessment documents.
Monitoring	Management should use a number of systems for monitoring the ongoing relevance and appropriateness of the documents relating to work procedures or method statements.
5. Peer group Attitude	
Fostering a Supportive environment	Management should allocate sufficient time and resources to enable workers to develop strong working relationships, and to take responsibility for their own and others health and safety.
Empowerment to Stop work	Management should nourish an open and honest culture where workers feel confident to stop work when they feel unsafe.
6. Accident and Near miss Reporting	
Near miss reporting	Management should ensure that workers understand near misses, e.g. What should be reported, and how The information reported can be used to improve health and safety performance on sites.
Valuing reports	Management should take prompt and appropriate actions to respond to workers' reporting.

2.6 Previous Empirical Research on Construction Safety

According to some literatures there is very little literature relating directly to the safety on construction sites in developing countries like Ethiopia.

Throughout the EU there is a growing recognition that standards of occupational safety and health in construction have to be improved. Each year, in the original EU-15 Member States alone, about 1300 workers are killed, another 800,000 injured and countless more suffer ill health.

Though most of the existing studies were conducted in developed countries, it is believed that their findings will be applicable in most situations in the developing nations as well.

Studies that are available on industrial injuries in Africa indicated that work-related injuries appeared with greater frequency and severity. For instance, the injury rate among small scale industrial workers in Zimbabwe was 131 per 1000 exposed workers per year (Loewenson, 2004). In Ethiopia, very limited attempts have been made to identify work-related injuries and their determinants even among large industrial workers (Takele.Z, 2011).

In the United States construction sector employees only 6% but almost 20% of the fatality is in the construction sector, the largest fatality of any other sector (ILO, 2009).

Around five percent of construction accidents occur during excavation work. The categories used for classifying fatal accidents were: falls, falling material and objects, electrical hazards, transport and mobile plants, and other. The majority of accidents that involved falls occur during work on roofs, scaffolds and ladders. Collapses of structures and falling materials also account for a large proportion of fatalities (Helander, 1991).

Most workers under 26 years of age had relatively low safety performance scores, relatively little knowledge about safety and an unfavorable attitude towards safety performance. The study conducted by (Dedobbeleer and German, 1987) concluded that: (1) falls are the most serious hazard; (2) research on safety motivation shows that hazard recognition is an essential element; (3) many accidents involve hand tools. Ergonomics can improve safety through better design; (4) protective equipment needs to be comfortable. Also discussed the psychological aspects of safety, such as motivation and attitudes. It suggested a shift from the current practice of training which stresses the desirability of safety to a subtler approach which asks what methods are available to motivate and change attitudes of construction related personnel to improve safety (Seifedin.S, 2014).

A study conducted in a developing country, in Pakistan, by Farooqui, Arif and Rafeeqi (2008) who investigated the safety performance measurement of various construction firms as well as the overall construction industry of Pakistan based on an investigative site survey. The findings of the study were as follows. The top three safety non-performance practices at building construction work sites are (1) ear defenders not worn (while using noisy equipment); (2) protective footwear not worn; and (3) face masks not worn (in dusty conditions). Most of the safety non-performance issues belong to self-protection category. This showed that the site workers themselves were either unaware of the importance of personnel safety practices or they do not want to wear protective gears and kits as they consider it as a hindrance in their work productivity (Farooqui et al, 2008)

2.7 Investigations In To the Underlying Causes of Fatal Accidents

Abraham (2008) indicated that the most likely reason of causes of injuries are unsafe attitude followed by poor site management, unsafe procedures at the workplace, not wearing proper protective gear, lack of knowledge and experience and unsafe condition such as hazardous materials and dangerous elevations poor health and safety monitoring and enforcement, lack of cooperation between management and workers and lastly unavoidable hazardous conditions at the project site.

2.7.1 Causes of Accident

Accident don't just happen, they are caused. Ninety percent of the accident are caused by either unsafe acts or unsafe conditions or both (Ridley, 1986). As such, accidents could be prevented. The unsafe act is a violation of an accepted safe procedure which could permit the occurrence of an accident. The unsafe condition is a hazardous physical condition or circumstances which could directly permit the occurrence of an accident. The following causes of accident were obtained from Addis Ababa city labor affairs bureau, 2008 and Ridley, 1986

a. Ignorance and luck of training

The majority of plant equipment related accidents stem directly on the operator's misuse of such things. There are also numerous reasons for the incorrect usage of plant and equipment, the most common is operator's ignorance of the correct method of usage.

The "it cannot happen to me!" attitude is regarded as the biggest single root cause of construction related or any other types of accidents

b. Carelessness

Carelessness wills always be the prime contender for the role of "root causes" in any accident in construction especially involving young people.

A substantial number of potential accidents can be avoided instilling in such people that the earliest possible opportunity the need to take care in what event they are doing by apprising what will happen if they don't.

c. Lack of Discipline

This is also anther common cases of accident involving young persons at construction site.

d. Distraction

Accidents resulting from distraction are numerous and ranges from the comparatively minor variety to serious and possibly fatal instances.

e. Communication

There are two rules regarding communication

i. Ensure that all instructions are clear and unambiguous

ii. By way of ensuring that what was heard what was meant, check that the instructions have been fully understood

f. Accidents related to Plant, Machinery and Transport

Striking personnel, Collisions and Overturning

The majority or plant - or transport- related accidents fall within this category.

Lifting appliances

The majority of such accident consists either of personnel being struck by swinging loads or of variety sustained in sliding operations or while using pulley blocks.

Pneumatic and power tools

Most accident in this category occur either through the misuse of tools or a lack of concentration on the part of the user.

g. Others

Lack of proper training; deficient enforcement of safety; safety equipment not provided; unsafe methods or sequencing; unsafe site conditions; not using provided safety equipment; poor attitude toward safety; and isolated and sudden deviation from prescribed behavior. And also poor safety awareness from top leaders; lack of training; poor safety awareness of project managers; reluctance to input resources for safety; reckless operation; lack of certified skill labor; poor equipment; lack of first aid measures; lack of rigorous enforcement of safety regulation; lack of organizational commitment; low education level of workers; poor safety conscientiousness of workers; lack of personal protective equipment;

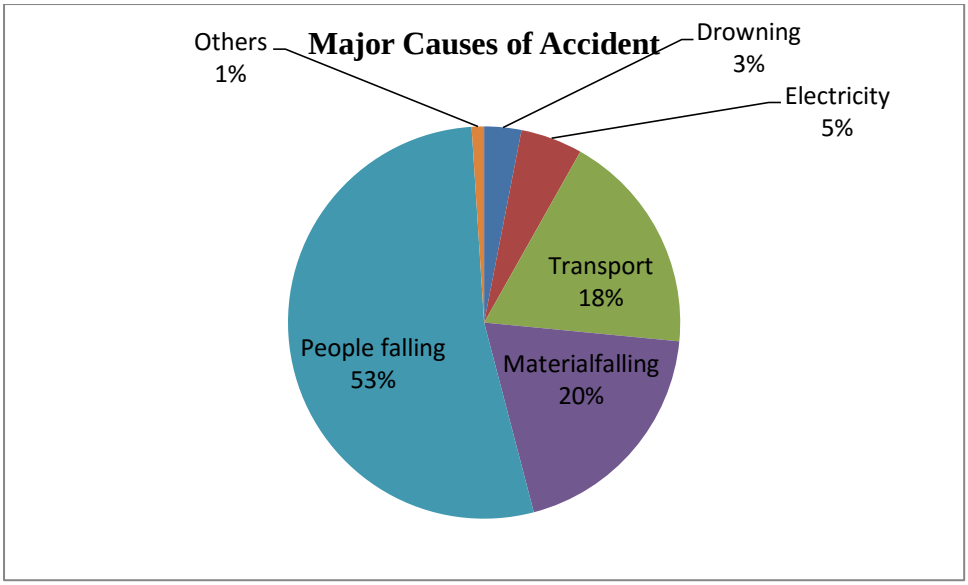

Figure 2: 3 Distribution of Major Causes of Accident in Construction Industry (Addis Ababa city labor and social affairs, 2008)

Figure 2 .3 shows that the major causes of construction accidents are people falling, drowning, material falling, electricity and transport. Among them the most frequently caused accident is people falling and material falling.

2.7.2 Major Safety Obligations for Construction Site Personnel,

Among the obligations of employers set by labor proclamation 377/2003 article 92(2) of FDRE an employer 'should take appropriate steps to ensure that workers are properly instructed and notified concerning the hazards of their respective occupations and the precaution necessary to avoid accidents and injury to health'.

Safety officer/ Manager

Every construction company of any size should appoint a properly qualified person (or persons) whose special and main responsibility is the promotion of safety and health.

1. Establish and maintain a safety policy, and provide a safe workplace.
2. Ensure compliance with regulations, proper training of workers and arrange induction courses for new employees.
3. Provide PPE, warning signs and ensure that regular inspection and maintenance of all plant and equipment are done.
4. Provide first aid facilities; correct unsafe conditions and attend promptly to all equipment defects.
5. Investigate and report all accidents

Supervisor/Forman

Good planning and organization at each work site and the assignment of clear responsibility to supervisors are fundamental to safety in construction. “Supervisor” here means the first level of supervision, which on site is variously termed as “foreman”.

1. Comply with regulations, promote safety awareness, establish safe work procedures, incorporate safety instructions in routine orders and instruct workers appropriately.
2. Report and correct unsafe practices and conditions.
3. Detect and discipline troublesome employees.
4. Enforce safety rules, regularly inspect site for any hazards and investigate all accidents.
5. Assess condition of and

Workers

Every worker is under a moral, and often also a legal, duty to take the maximum care for his or her own safety and that of fellow workers.

1. Use safe work procedures and use the correct tools and equipment, including PPE.
2. Report unsafe practices and conditions and report any injury.
3. Make suggestions for improving safety standards.
4. Comply with and observe rules, regulations, and follow instructions issued by supervisors for purposes of individual as well as collective safety.
5. Set a good example to fellow to O.S.H. Department and Workmen’s Compensation Section. regularly maintain equipment.

In general accidents are caused by a wide range of factors, some of which are:

1. Lack of awareness of safety regulations;
2. Lack of enforcement of safety regulations;
3. Poor regard for safety by people involved in construction projects;
4. Engaging incompetent personnel;
5. Non-vibrant professionalism;
6. Mechanical failure of construction machinery/equipment;
7. Physical and emotional stress; and
8. Chemical impairment.

And direct influence on accidents as illustrated in Figure 2.4. Furthermore, in addition to discussion of individual factors it was noted that account needed to be taken of the interaction between the factors, and the influence one factor exerted on another. Parallel thinking underpins the structuring of the Influence Network Model which follow.

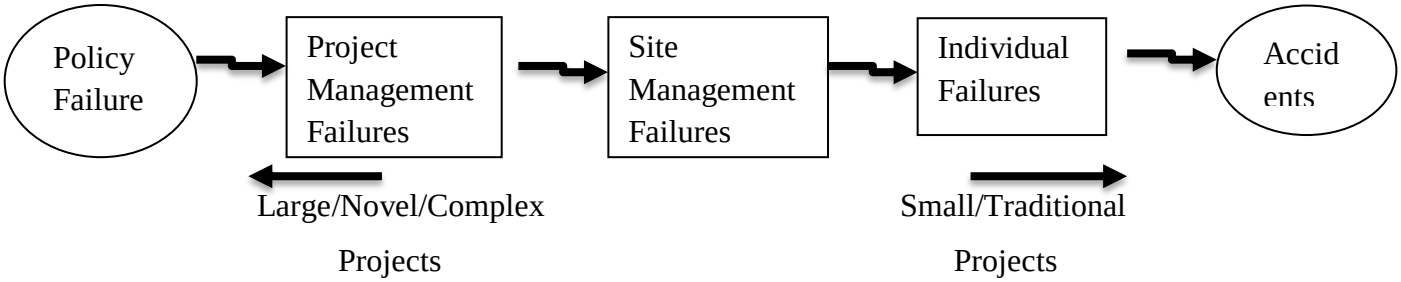

Figure 2: 4 Representation of the sequential influence on accidents reflected in different types of projects (HRA, 1992)

Competence (in the form of 'inappropriate actions being chosen / applied') and poor planning in the form of 'deficient risk assessments and / or method statements'.

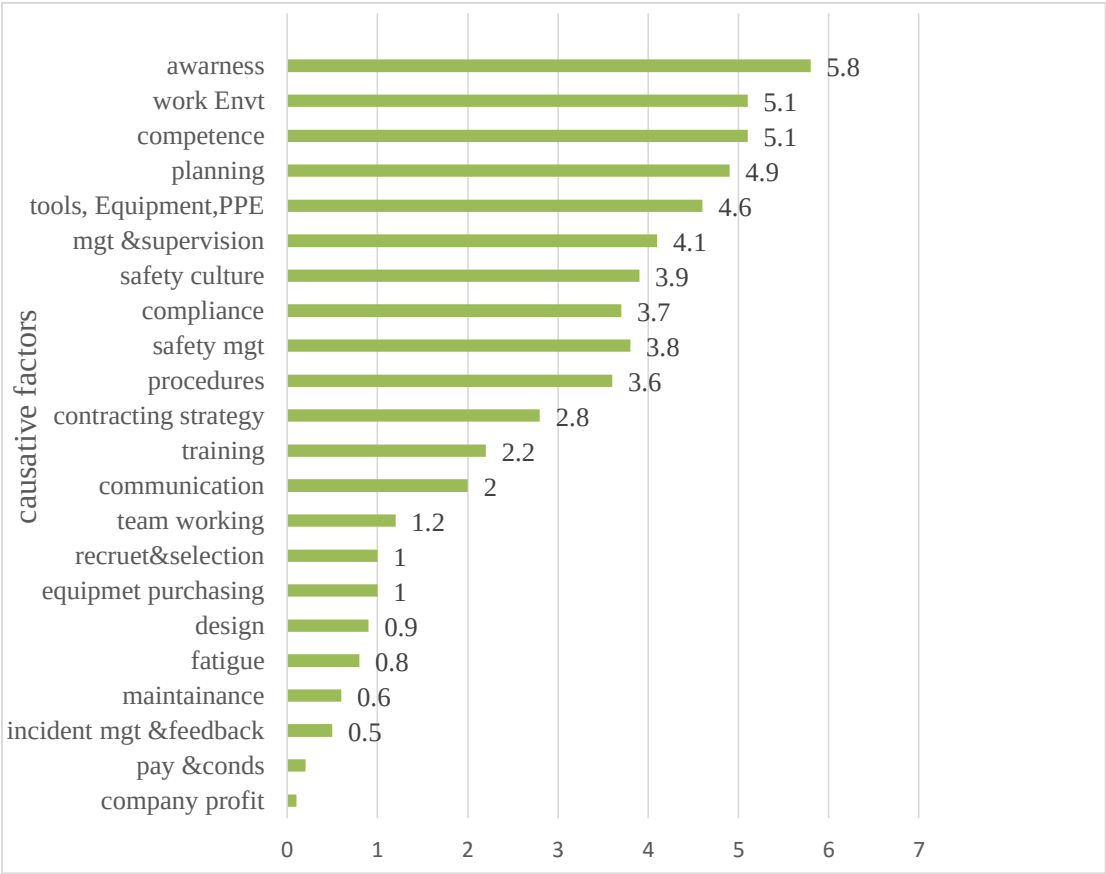

Figure 2: 5 Causative Factors in Sample Construction Fatalities (BOMEL, 2003a)

From interpretation of the above results it appears there are real failures in organizations' abilities to assess risks adequately and communicate these risks to workers in order to ensure that they are not only aware of the risks they are exposed to, but also able to behave appropriately in the face of such risks by following a set of practical and workable procedures to which they have contributed and / or about which they have been consulted.

Figure 2.5 shows details of the subsidiary factors associated with some of the more frequent causes and the report provides some detailed discussion regarding the basis for the lack of appreciation of the risks by workers and the potential interaction with apparent failings in competence (incorrect action taken) and compliance.

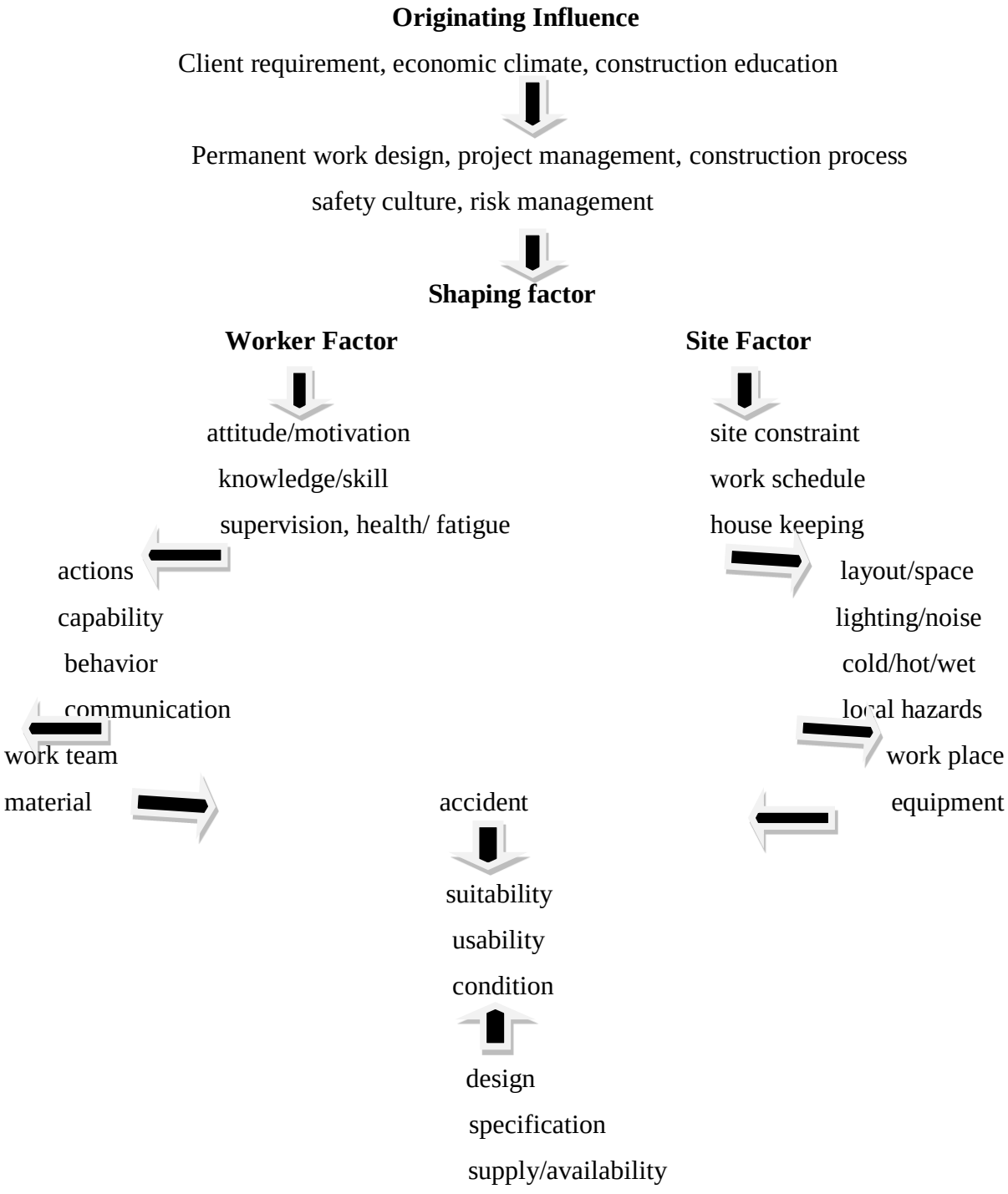

Figure 2: 6 Prevention of Construction Accident (BOMEL, 2003)

2.8 Accident Costs

Accident costs as any cost resulting from an accident occurrence, Boot, *et al.* (2005). According to Kartan (1995) construction accidents cause many human tragedies, demotivate construction workers, disrupt construction processes, delay progress and adversely affect the cost, productivity and reputation of the construction industry.

Accidents in the construction industry represent a substantial ongoing cost to employers, workers and society (Haslam, *et al.* 2004). Mitropoulos *et al.* (2004) observes that cost pressure may prevent management from providing the required safety measures or appropriate tools and equipment.

The cost of accidents affect the profit of the construction companies so it is uneconomical to allow workers to give up work as a result of work-related accidents and ill health (Carcoba 2005) The true cost of accidents is not only the economic costs to the construction industry but also the social costs such as pain and sufferings of the affected workers, emotional and psychological impacts caused to friends, families and co-workers.

Ferret (2005) identifies that any accident or incidence of ill health will cause both direct and indirect costs.

Direct Costs

Direct costs of accidents are those directly attributed to or associated with injuries.

The direct costs according to Ferret (2005) are;

- ✓ claims on employers and public liability,
- ✓ insurance,
- ✓ damage to buildings and equipment or vehicles,
- ✓ damage to the product;
- ✓ cost of health or expenditure on medical care,
- ✓ cost of investigation, death, permanent disability;
- ✓ worker illness and injury; these costs are usually covered by workers' compensation insurance policies.
- ✓ losses of current production; pains and discomfort associated with accidents,
- ✓ cost of penalties.

Indirect Costs.

Indirect cost of accident are usually related to the loss of productivity and added administrative effort. Productivity will be immediately affected once accident occurs

According to HSE (2005), indirect or hidden costs are the cost incurred by the diversion of people's time to deal with the consequences of an accident which includes,

- ✓ giving first aid,
- ✓ accident investigation,
- ✓ preparing reports,
- ✓ repairs, the costs of changing machinery,
- ✓ hire costs of temporary equipment,
- ✓ waste disposal,
- ✓ temporary labor,
- ✓ customer penalties, and possibly fines and costs from prosecution.
- ✓ incidental cost due to interference with production
- ✓ cost to employer under employee welfare and benefit system
- ✓ cost to employer for continuing wages of injured worker
- ✓ cost due to loss in profit due to reduced worker productivity
- ✓ cost due to loss in profit due to idle equipment
- ✓ cost incurred because of subsequent injuries partially caused by the incident
- ✓ cost of overhead (utilizes, telephone, rent, etc.)

The ILO,2009 has estimated that 4% of annual global gross domestic product, or US$2.8 trillion, is lost due to the direct and indirect costs of occupational accidents and diseases, including lost working time, workers' compensation, interruption of production, and medical expenses.

Table 2: 3 Summary of indirect costs related to medical case injuries (Source: Hinze, 2000)

Involved parties	Indirect cost
Injured workers	-productive hours on the day of injury - productive hours subsequent to the day of injury
Transporting the worker	-productive hours on the day of injury -hours of vehicle time and mileage
Crew cost	- hours lost by reduction of a crew
Workers idled by watching	-hours of other workers time
Damaging material	-hours of work time to repair -hours of work time to restore work condition
Supervisory time	-hours to assist injured workers - hours to investigate the accident - hour to complete the report
Replacement worker	-hours of lost productivity

Since accidents are associated with undesirable cost, both direct and indirect costs, it generated another terminology: the cost of safety.

The cost of safety are those cost incurred as a result of emphasizing safety issue, including personal protective equipment and safety program.

Construction practitioners usually focus only on the cost of safety rather than the cost of accident. They ignore safety issue to reduce the cost of safety. However, the direct and indirect cost of accident may override the cost of safety, which result a greater lost suffered by the company.

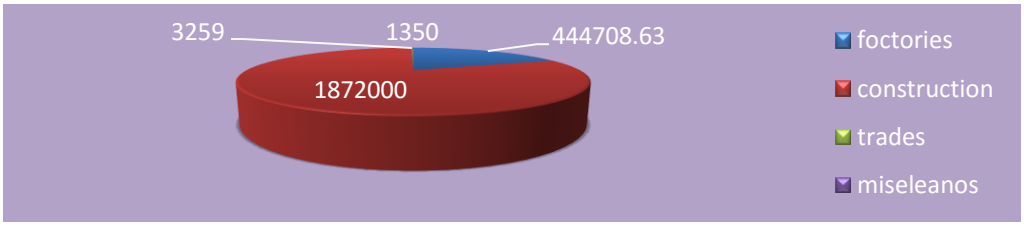

Figure 2: 7 General Costs related to Safety, Health and Welfare in the Construction Industry (Source: Addis Ababa city of labor and social affairs bureau)

Indicators on the costs of poor health and safety implementation in the industry can be determined as the following:

- Lost time costs
- Fines
- Liabilities
- Legal costs
- Costs of shutdowns/site closures
- Inquiries, etc.

Based on labor statistics convention world labor statistics countries collects working environment data every year because of they want to prevent health and safety of workers at work. Even though Ethiopia had not have written labor statistics convention the labor and social affairs minister tried to collect work place data.

The following accident data is collected by labor and social affairs minister in 2005 and 2006 E.C

1. In 2005 E.C 234 organizations reported their accident 31 organization from Addis Ababa, 145 from Oromia, 9 from southern nation and nationality and peoples and 48 from Amara. Total accident reported is 3814, series and slight accident 3796 and 18 fatal 34677 days are loss time due to the accident. Among the other sectors construction sector is the first with loss times 18099 days, second factories 7883.5 days loss time and the third one farm, hunting and fishing 5250 days loss time.
2. Similarly in 2006 E.C 233 organizations reported their accident 40 organization from Addis Ababa, 146 from Oromia, 29 from Tigray and 21 from Amara. Total accident reported is 2396, serious and slight accident 2365 and 31 fatal 44188 days are loss time due to the accident. Among the other sectors construction sector has the first with loss times 14424 days, second factories 9335 days loss time and the third one farm, hunting and fishing 8279 days loss time.

Table 2: 4 Lost time in days and percentages comparing construction industry with different sectors in Ethiopia (Ministry of Labor and Social Affairs Bureau, A.A, 2008)

Sector	2005 E.C		2006E.C	
	loss time in days	Percentage (%)	Lost time in days	Percentage (%)
farm, hunting and fishing	5250	15.14	-	
Factories	7883.5	22.73	8279	18.74
Construction	18099	52.19	14424	32.64
Electric, gas and water	-	-	9335	21.12
Others	3444.5	9.94	12150	27.50
Total	34677	100	44188	100

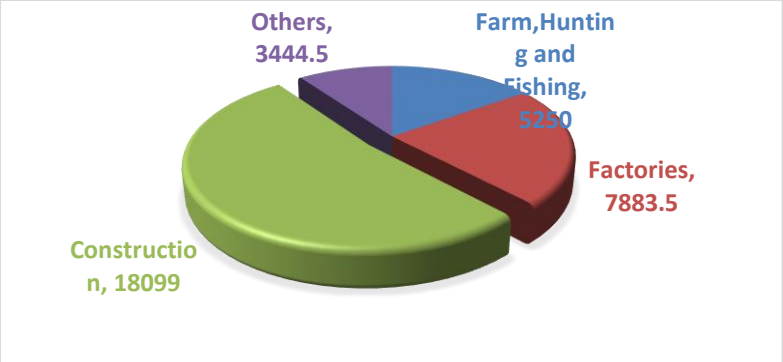

Figure 2: 8 Lost work time in days in 2005 E.C (Source: Addis Ababa city of labor and social affairs bureau, 2008)

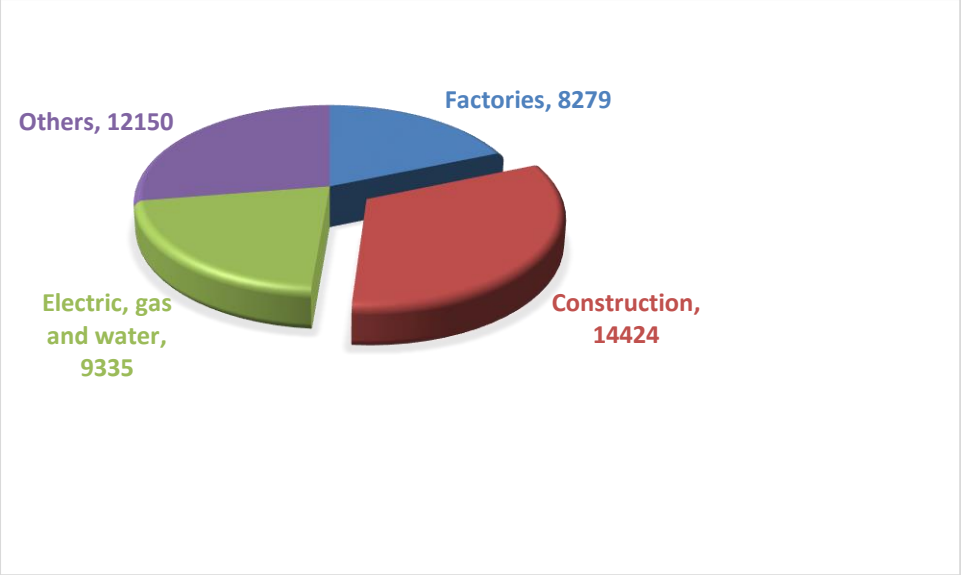

Figure 2: 9 Lost work time in days in 2006 E.C (Source: Addis Ababa city of labor and social affairs bureau, 2008)

The high injury rate and the associated number of persons who leave the industry due to work related injury means that the industry could face greater difficulty in attracting, retaining and training employees than would otherwise be the case. This potentially represents a large cost to the industry. It is also a significant cost to society in the form of healthcare, social welfare and loss of the quality of life for individual workers and their families. In addition, the requirement to employ immigrant workers to replace those who leave the industry imposes housing, infrastructural and social costs that would not otherwise be required.

The factor most associated with increases in accident rates in international studies is economic expansion in a particular sector. The growth rate in the construction sector continues to be unusually large; it is critical therefore that the construction regulations adequately address the key issues involved in construction accidents.

Legal costs in relation to health and safety performance relate to two issues: employee claims and enforcement actions. Employees injured on sites due to the negligence of employers/clients/etc. could make insurance claims or take civil cases against those responsible. In the cases of fatalities, legal representation may be required at inquests. Liability insurance premiums are also likely to be affected by legal actions.

The Economic Impact of Construction Accidents

Owners have a direct economic stake in the safety performance of their contractors because accident costs are an expense to the contractor and are passed on, one way or another, to the client. This is obvious in cost-reimbursable contracts, but it also applies to fixed-price contracts.

Owners must consider three kinds of costs when dealing with safety in construction:

- Direct costs of accidents and insurance
- Indirect costs of accidents
- Costs of safety programs

I. Direct Costs of Accidents and Insurance

Workers' Compensation

Most contractors buy insurance for their workers' compensation (WC) exposure. Those that do not are either self-insured or are covered by insurance carried by their client. The cost of insurance coverage varied with the contractor's accident record, which is based on the contractor's injury costs in a given geographical area, expressed as an experience modification rate (EMR).

According to Ethiopian labor proclamation article 109 sub article 2 an employer shall pay a lump sum of disablement compensation to workers. Sub article 3 of this article also indicated that the amount of disablement compensation to be paid by the employer shall be (a) where the injury sustained by the worker is permanent total disablement, a sum equal to five times his annual wages;

(b) where the injury sustained by the worker is below permanent total disablement a sum proportionate to the degree of disablement calculated on the basis of the compensation provided.

Liability

Accidents resulting in injury to anyone other than one's own employees or damage to the property of others constitute liability exposures. Coverage for general liability, automobile liability, and completed operations is considered to be a part of liability costs. In addition to the actual insurance premium, other expenses such as deductibles and legal fees should be considered in compiling total costs to the contractor for liability. Published rates exist for liability insurance coverage; however, the cost is relatively insignificant compared to workers' compensation rates. There are certain high risk operations which may command insurance premiums in the range of 15% of direct labor payroll; however, most contractors pay about 1% for liability coverage.

According to Ethiopian labor proclamation law article 96 sub article 1 states that the employer shall be liable, irrespective of fault, for employment injuries sustained by his worker and article 2 states that the employer shall not be liable for any injury intentionally caused by the injured worker himself; (a) non-obedience of express safety instructions or non-observance of the provision of accident prevention rule specifically issued by the employer; or (b) reporting to work in a state of intoxication that prevents him from properly regulating his body or understanding.

Property

Real property, such as the facility under construction and construction equipment, provide a potential for accident sand resulting losses. The costs of such insurance as builder's risks, equipment floaters, and installation floaters must be considered. In addition to the insurance premiums, deductibles and the possibility of losses affecting uninsured property should be considered. Accidents in construction work that is underway may bring catastrophic losses, either because of the severity of the accident itself, or because of resulting long delays in completing the work or both.

II. Indirect Costs of Accidents

The insurance costs discussed so far are readily identifiable as a specific cost of doing business and may therefore be projected. However, when an accident occurs, not only direct by indirect costs are involved. Indirect costs include:

- Loss of productivity
- Disrupted schedules
- Administrative time for investigations and reports
- Training of replacement personnel
- Wages paid to the injured worker (s) and other workers for time not worked
- Clean up and repair
- Adverse publicity
- Third-party liability claims against the owner
- Equipment damage

III. Cost of Safety Programs

Insurance costs, costs of injuries, and the expense of liability suits are easily documented and rather readily available. The cost of establishing and administering a construction safety and health program is less tangible, but it can be estimated with reasonable accuracy.

These costs include:

- Salaries for safety, medical and clerical personnel
- Safety meetings
- Inspection of tools and equipment
- Orientation sessions
- Site inspections
- Personal protective equipment
- Health programs such as respirator-fit tests
- Miscellaneous supplies and equipment

The construction industry policy of Ethiopia aimed at creating an enabling environment for the development of a vibrant, efficient and sustainable local industry that meets the demand for its service to support sustainable economic and social development objectives. The construction sector has showing its increased percentage share to the country GDP at constant basic price from 4.3% in 1993 E.C to 5.8% by 2002 E.C (sited in Tolora, International Journal of Research,2016).

CHAPTER THREE
METHODOLOGY

3.1 Study Design

This chapter presents the research method to achieve the objective of the study and to answer the initial research questions.

Research methodology is a plan and a procedure for research that span the decisions from broad assumption to detailed methods of data collection and analysis.(Creswell, 2007)

Mixed methods research is an approach to inquiry that combines both qualitative and quantitative forms. The mixed method approach better than the two methods alone because it provides more information and better quality of information.

Methods adopted

The researcher adopts the mixed method approach based on its suitability and strength for this research study, statistical analysis of construction site accident in Ethiopia.

With the disproportionately of high number of accidents in the construction industry this study was aimed at developing the rate of construction accidents per the number of employees.

The research methodology for this study consisted,

- Previous research on construction accident was studied
- The existing data on construction accident was collected
- The fatalities and injuries was identified
- The data was tabulated to understand easily

1) previous research on construction accident

   Construction accidents on developed countries, developing countries and nationally in Ethiopia were examined to provide related issues and recognized the context of accidents in this study.

2) The existing data on Ethiopian construction industry were collected

   The existing data or means that reported construction accidents in four regions in Ethiopia from Addis Ababa labor and social affairs bureau were collected.

3) Fatalities and injuries were identified

   The fatalities and injuries in Ethiopian construction industry based on the available data were identified

4) The data were tabulated and analyzed to understand easily

   The available accident data were arranged on tables and analyzed based on the sex, age, causes and types of injuries to understand easily.

3.2 Target population

The target population includes all construction companies and consultants, employees, laborers and owners in Ethiopia. The representative companies are from Addis Ababa, Tigray, Amara, Oromia and South nations and nationality and peoples. There is assumption that greater than 50% of construction is in Addis Ababa, therefore the sample including these four regions represent for Ethiopian construction company site accident analysis.

3.3 Data Collection

The data collection method is by using primary and secondary data. The primary data have been collected by site surveying and interviewing and filling questionnaires by the workers for the purpose of general site safety and safety equipment utilization and also how to occur site accidents. The secondary data mainly obtained from ministry of labor and social affairs bureau and Addis Ababa police commission and fire and emergency control and prevention Addis Ababa. The necessary data collected were slight, serious and fatal injuries among construction workers.

The secondary data collected from ministry of labor and social affairs bureau includes construction companies from Addis Ababa, Tigray, Amara, Oromia and SNNP survey and reported data in 2005, 2006 and 2007 E.C and also only reported accidents from 2002 to 2008 in Addis Ababa construction and consulting firms. From Addis Ababa police commission only death cases were obtained.

3.4 Data Analysis Method

The data were analyzed based on the characteristics of the accidents comparing on the basis of time, location, age and sex of workers and victim characteristics. Histograms and tables were utilized to isolate unique aspects of fatalities and injuries. The nature of the data required does not lend itself to analyze by complex statistical procedures. Rather the results are represented in simple comparative form in order to gain insight in to the characteristics surrounding accidents.

The rate of fatal injuries in 2005, 2006 and 2007 per 1000 workers and employees were calculated using the following formula

$$\text{injury rate per 1000 employees} = \frac{\text{No of occupational injury}}{\text{employment size}} X1000$$

$$\text{injury rate per 1000 workers} = \frac{\text{No of industrial injury}}{\text{employment size}} X1000$$

CHAPTER FOUR
RESULTS AND DISCUSSIONS

In this chapter the secondary data result analysis held followed by discussions. Since the data collected are searched or surveying from September to august in each year it is important to note that all of the year are in Ethiopian calendar. The accident data collected from Addis Ababa city of labor and social affairs bureau includes 2005 to 2007 E.C. In 2007 the accident report includes all regions except afar region. However the other years 2002 to 2004 , 2008 and 2009 accident data are only reported from Addis Ababa city by 10 to 18 companies. And the main focus is on Ethiopian construction sites accident.

During the research study in addition to secondary data the researcher performed personal observation of construction site, questionnaires and interviewed some employees and contractors. According to the observation most of the laborers in high rise buildings had done without PPE, even laborers at road constructions also walk very close to working heavy equipment like trucks and cranes. The following pictures (Fig 4:1 and Fig 4:2) are taken during site observation in Addis Ababa.

Figure 4: 1 Road construction "Mexico sub city to lideta " in Addis Ababa

Figure 4:1 were taken from road construction in Addis Ababa. According to international OHS standard construction site should be fenced to protect people from site accident. However in this site peoples and laborers walk very near to the construction plants, is working and cross the excavated land even the Forman sits very near in front of the excavator since there is no enough space this interns cause to an accident.

Figure 4: 2 Smart Parking Construction in Addis Ababa around ‘zefmesh’ grand mole

Figure 4:2 had taken from high rise parking construction in Addis Ababa. Workers working on high rise construction should be used safety harass to protect accident caused by falling from height and also should use safety helmets to protect from the bolts and nuts that used as a connector for the metals may drop from the top. However these workers execute their work without using safety equipment.

4.1 Results for primary data

The data is collected from contractors and consultants employees. six from contractors and 3 from consultants. Out of 100 questioners distributed to managers, supervisors, foremen and daily laborers 70 properly completed were returned back. The contractors are general and building contractors. And the questioners were prepared by English and Amharic.

Table 4: 1 Category of companies included in the sample

Company type	No of companies included	No of respondents
Contractors	6	55
Consultants	3	15
Total	9	70

4.1.1 Respondents personal information

Table 4.2 presents the summary of personal information of the respondents, age, gender, work position, employment experience and educational background.

Table 4: 2 Respondents personal information

Age	14-24	25-35	36-46	>46	Total
Frequency	5	49	14	2	70
Percent	7.14	70	20	2.86	100
Gender	M/F	M/F	M/F	M/F	
Frequency	2/3	35/14	11/3	2/0	70
Percent	2.86/4.29	50/20	15.71/4.28	2.86/0	100
Educational background	High school and bellow	College diploma	College degree	Above	
Frequency	21	14	31	4	70
Percent	30	20	44.28	5.72	100
Employment experience	< 1 year	1-4 years	5-10	>10	
Frequency	14	32	21	3	70
Percent	20	45.71	30	4.29	100

4.1.2 Descriptive Analysis

The descriptive statistics is obtained based on questionnaires and interviews of workers, foremen, supervisors and contractors on some construction sites in Addis Ababa. The questions are generally about OSH that can be answer by all employees and employers. Numerical values were assigned to each of the survey responses, so that strongly disagree = 1, disagree = 2, agree = 3, and strongly agree = 4. Lower means scores indicate stronger disagreement whereas higher mean scores indicate stronger agreement for each of the questions. Data are presented as percentages and mean ± standard deviation (STD).

The descriptive statistics is presented in table 4.3

Table 4: 3 Description of the frequency of responses for each of the OSH questions answered by laborers, Foremen, supervisors and managers

S/No		Strongly disagree		Disagree		Neutral		Agree		Strongly agree	
		Frequency	Percent	Frequency	Percent	Frequency	percent	Frequency	Percent	Frequency	percent
1	The project manager really cares about the health and safety of the people who work here	-	-	4	5.71	9	12.85	46	65.71	11	15.71
2	First aid kit is available and easily accessible with sufficient materials in it	-	-	-		6	8.57	61	87.14	3	4.28
3	The project manager sometimes turns a blind eye when health and safety procedures/ rules are broken	-	-	10	12.28	3	4.28	53	75.71	4	5.71
4	There should be a strong policy or regulation for the implementation of safety and health by the government	-	--	47	67.28	-	-	21	30	2	2.86
5	Supervisors proactively monitor what is happening in the work group to have an early warning of emerging issues	-	-	42	60	13	18.71	10	12.28	5	7.14
6	There is sometimes pressure to put production before safety	-	-	-	-	5	7.14	41	58.57	24	34.29
7	The company provides safety orientation for new employees	-	-	2	2.86	-	-	53	75.71	15	21.43
8	The company provides adequate training to the work force to exceed safety standards	-	-	48	68.57	-	-	9	12.86	13	18.71
9	The project management team is only interested in safety after occurring an accident	12	17. 14	49	70	3	4.28	6	8.57	-	-
10	There is good communication at sites about health and safety issues which could affect workers	-	-	48	68.57	-	-	7	10	15	21.43
11	Workers at sites have high levels of job satisfaction	-	-	42	60	9	12.86	4	5.71	15	21.43
12	At sites there are no barriers stopping us from working well with each other	-	-	17	24.29	-	-	42	60	11	15.71
13	Open reporting of mistakes and errors encourages that could affect health and safety	-	-	3	4.29	-	-	61	87.14	6	8.57

14	Safety performance indicators are used by managers to improve safety	-	-	6	8.57	8	11.43	37	52.86	19	27.14
15	If an accident occurs, managers at sites do not blame workers but consider other organizational causes, such as communication and work design	8	11.43	13	18.57	2	2.86	47	67.14	-	-
16	Workers in construction always given feedback about incidents that have occurred	-	-	7	10	8	11.43	49	70	6	8.57
17	The laws, directives and regulation of the country regarding health and safety are known and implemented by management of the company	-	-	5	7.14	5	7.14	49	70	11	15.71
18	A good record of safety performance does not stop managers from trying to identify safety problems	-	-	2	2.86	13	18.57	29	41.43	26	37.14
19	The project management team considers safety when setting production speed and schedule	-	-	3	4.29	7	10	44	62.86	16	22.86
20	Safety is a primary consideration in planning and allocating project resource	-	-	1	1.43			46	65.71	23	32.86
21	The project management team ensures workers are provided with required safety equipment	-	6	8.57	-	-	-	53	81.43	11	15.71
22	The company has a medical insurance for all workers	-	2	2.86	-	-	-	27	38.57	39	55.71
23	There are enough workers to carry out the required work safely, workloads are well managed and reasonable	-	-	-	-	10	14.29	54	77.14	6	8.57
24	Workers on this project are willing to report incidents	-	-	-	-	-	-	65	92.86	5	7.14
25	Workers are usually satisfied with the follow up and measures taken after accidents have taken place	-	-	-	-	16	22.86	33	47.14	21	30
26	when workers lose their working ability due to occupational accident, they are given compensation	-	-	-	-	14	20	31	44.29	25	35.71
27	The managers and foremen are willing to ask for health and safety advice from workers who have hands on experience	-	-	-	-	11	15.72	47	67.14	12	17.14
28	Managers provide constant encouragement to do the job safely			58	82.86	6	8.57	-	-	6	8.57
29	The accidents occurred usually due to employees mistake	11	15.72	13	18.57	32	45.71	10	14.29	4	5.71
30	The accidents occurred usually due to faulty procedure of work	-	-	-	-	-	-	61	87.14	9	12.86

Selected positive findings from workers response

- 42.86 % of workers agree that the project manager really cares about the health and safety of the people who work here
- 52.86% of workers agree First aid kit is available and easily accessible with sufficient materials in it
- 30% of workers agree that the company provides safety orientation for new employees
- 45.71% of workers agree that Open reporting of mistakes and errors encourages that could affect health and safety
- 61% of workers agree that the company has a medical insurance for all workers
- 37.71% of workers agree that The managers and foremen are willing to ask for health and safety advice from workers who have hands on experience

Selected negative findings from workers response

- 58.57% of workers disagree that supervisors proactively monitor what is happening in the work group to have an early warning of emerging issues
- 49% of workers agree that there is sometimes pressure to put production before safety
- 42 % of workers dis agree that managers provide constant encouragement to do the job safely
- 60% of workers disagree that there is good communication at sites about health and safety issues which could affect workers
- 6o% of workers disagree that workers at sites have high levels of job satisfaction
- 34.28 of workers disagree that there are enough worker-s to carry out the required work safely, workloads are well managed and reasonable

Selected positive findings from foremen, supervisors and managers response

- 80% of foremen, supervisor agree that safety performance indicators are used by managers to improve safety
- 95% of foremen, supervisor and managers agree that the project management team considers safety when setting production speed and schedule
- 56% of managers agree that safety is a primary consideration in planning and allocating project resource
- 32% of foremen, supervisor and managers agree that the project management team ensures workers are provided with required safety equipment

- 47% of foremen agree that there are enough workers to carry out the required work safely, workloads are well managed and reasonable
- 51% of foremen and supervisor agree that at sites there are no barriers stopping workers from working well with each other
- 92% of foremen, supervisor and managers agree that when workers lose their working ability due to occupational accident, they are given compensation

Selected negative findings from foremen, supervisors and managers response

- 49% foremen, supervisor and managers of workers disagree that there should be a strong policy or regulation for the implementation of safety and health by the government
- 38% of foremen and supervisors that workers at sites have high levels of job satisfaction
- 33% of foremen and supervisors disagree that Workers are usually satisfied with the follow up and measures taken after accidents have taken place
- 67% of foremen, supervisor and managers disagree that Workers in construction always given feedback about incidents that have occurred

4.2 Construction Site Accident Number by Age and Sex

Accident number by Age

In 2005 and 2006 the highest ranked accident is between 19 and 24 years old workers and the second is between 25 and 29 and the third in 2005 between 14 and 18, in 2006 between 30 and 39. The workers between 19 to 25 may not have enough knowledge and skill how to care their safety on work place, and workers greater than 50 old have most of the time have knowledge and skill on work place safety. However in 2007 the finding is very different from that of 2005 and 2006. Although the total number of workers less than 35 years old is greater than the number of workers greater than 35 years old, the first ranked accident in this year 2007 is from 40 to 44 years old workers and secondly from 30 to 34 years old workers.

Table 4: 4 Number of Accidents by Age in 2005 to 2007 E.C

Year	Age									
	14-18	19-24	25-29	30-34	35-39	40-44	45-49	>50	Unstated	Total
2005	108	323	238	102	59	51	33	18	-	
2006	12	279	82	52	42	37	22	16	-	
2007	-	13	21	68	8	84	3	4	822	

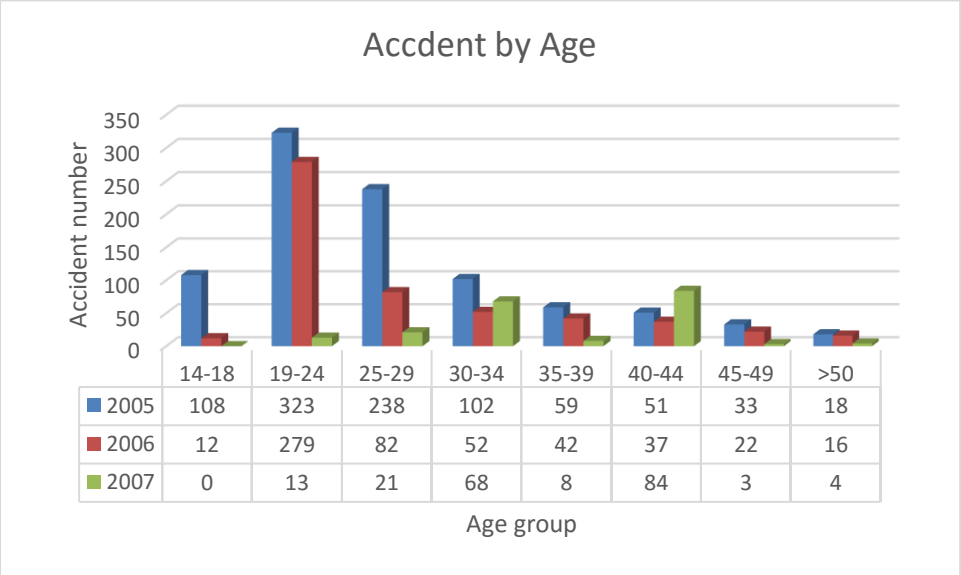

Figure 4: 3 Number of Accidents by Age 2005 to 2007 E.C

Accident by Sex

Generally the number of accident count on male workers are greater than accidents on female workers that is about 76% on male workers and 24% on female workers however out of total male workers only 9% accident and out of total female workers 3% accidents occur.

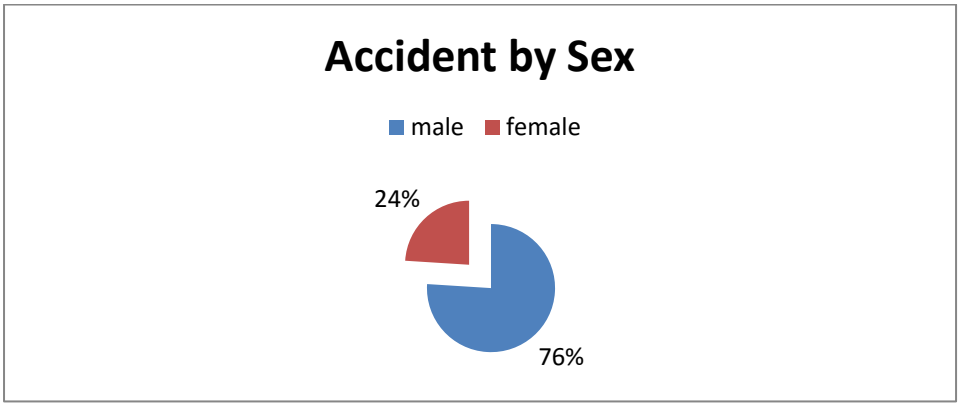

Figure 4: 4 Percentage of Accidents by Sex in Addis Ababa, 2008

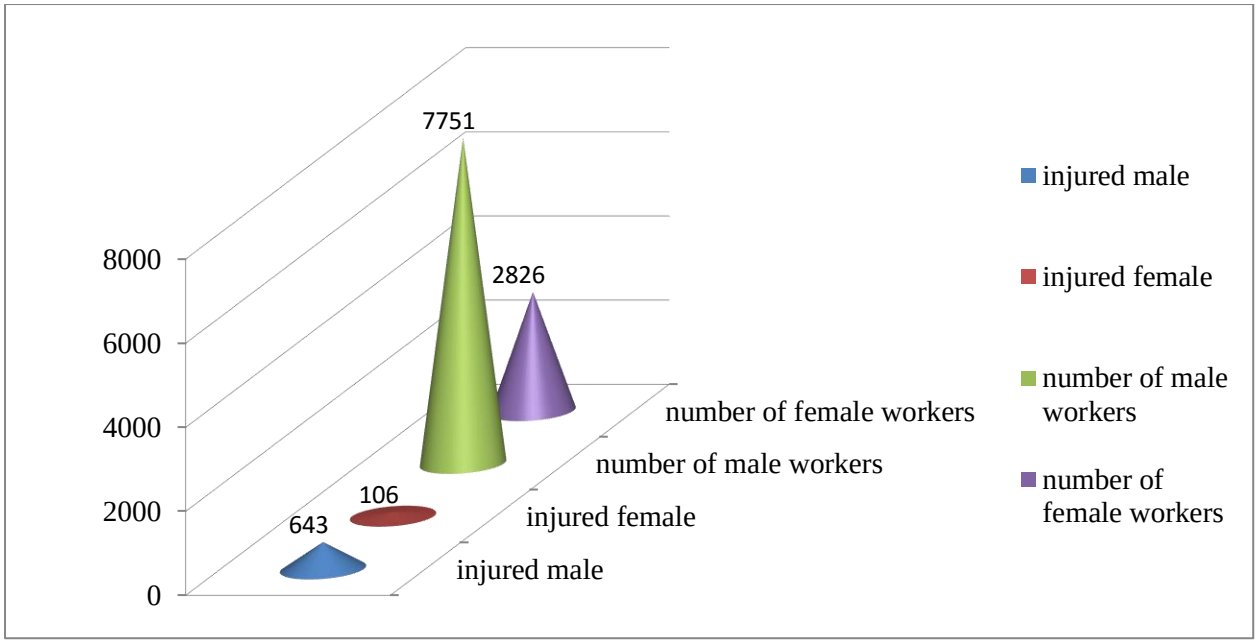

Figure 4: 5 Number of Accidents by Sex in Addis Ababa, 2008

4.3 Construction Site Accident by Causes of Accident

As we see in figure 4.6 in 2005 falling from height and slipping injuries was 211, injured while handling, lifting or carrying with 209 injuries and falling an object from height with 160 injuries have first, second and third stages respectively. Where as in 2006 generally the number of injuries have reduced but falling an object from height has first stage and hand tools and falling from height has second and third stages respectively in repetition. similarly in 2007 falling and slipping has higher frequency and the second is collision.

Most of the construction carryout recently in Addis Ababa and other regions of the country are high rise buildings so daily laborers injured while they doing their works without safety tools in high rise buildings. As we shown from the graph falling from height and falling an object from height are repeatedly occur on both years, 2005 and 2006. Mishandling also has high number of accident in 2005.

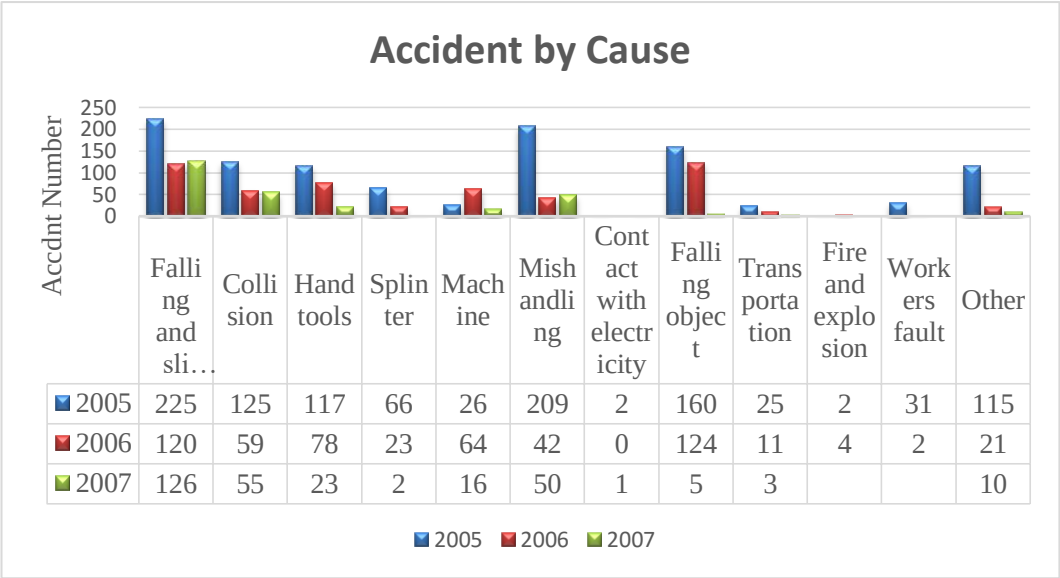

Figure 4: 6 Number of Construction Accident by Causes of accident

4.4 Construction Site Accident by Nature of Accident

In 2005 the highest accident in number is abrasion which is 540 injuries, the second and third are punctured and rupture each with 203 and 147 injuries respectively. In 2006 also the first highest in number is abrasion with 106 injuries the second is punctured with 94 injuries and third rupture 32 injuries. In 2007 punctured and abrasion injuries are first and second with 100 and 90 injuries respectively.

From this data we can conclude that in both years abrasion and punctured are commonly appeared type of injuries in Ethiopian construction industry.

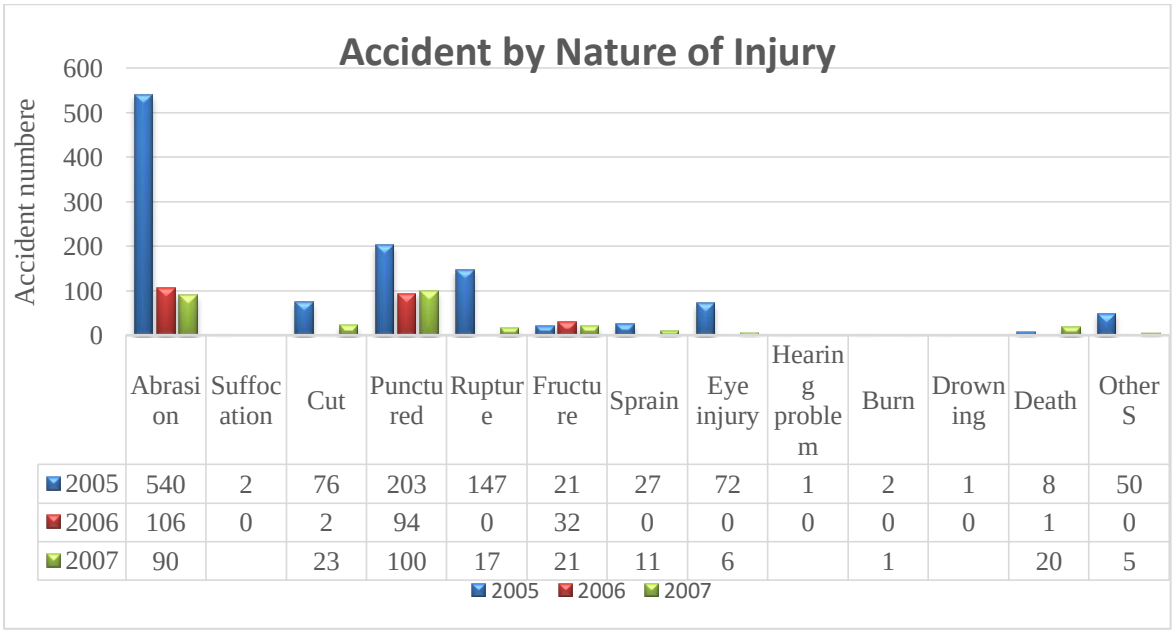

Figure 4: 7 Number of Construction Accident by Nature of Accident

4.5 Construction Site Accident by Day of Weeks

As we see in the figure 4.8 bellow 33% of the accident appears on the beginning of the week ,Monday and Tuesday and only 23 % on weekends, Friday, Saturday and Sunday. There is assumptions that laborers at weekends should feel tiredness because of continuous working through the weeks and that accident frequently happen at the beginning of the week this is happened because of laborers accomplished their social activity and drunk alcohols a lot at their rest day and they come to site with physically and mentally tiredness to the beginning of working days. However the graph tells almost the same throughout the weeks in Addis Ababa in 2008.

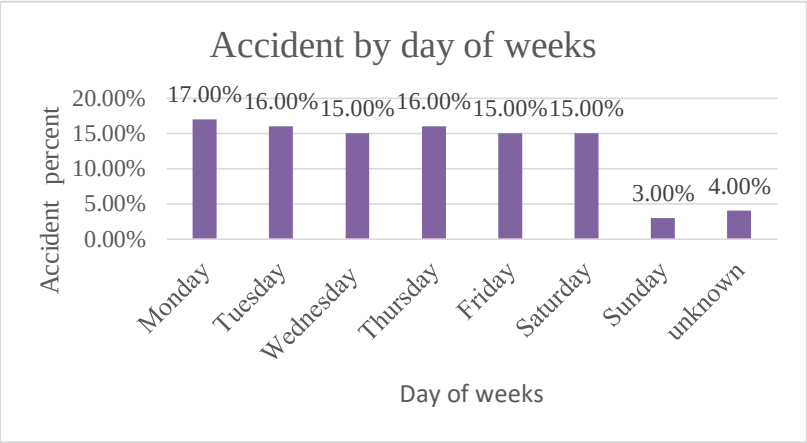

Figure 4: 8 Percentages of Construction Accident by Day of Weeks in Addis Ababa, 2008

4.6 Construction Site Accident by Injury and Death (Fatal injury and Non-fatal injury)

In 2005 there had 1191injuries, comparing with other years but 16 fatality happened on 2008 which is the first. The second in the frequency of non-fatal injury is in 2007 with 1001 injuries and third 2006 with 545 injuries. The first ranked in fatal accident is 23 fatalities, 21 of death accident is happened in one site in a day in this year 2009. The second in fatal injury is happened in 2007 with 20 fatalities and third in 2005 with 12 fatalities.

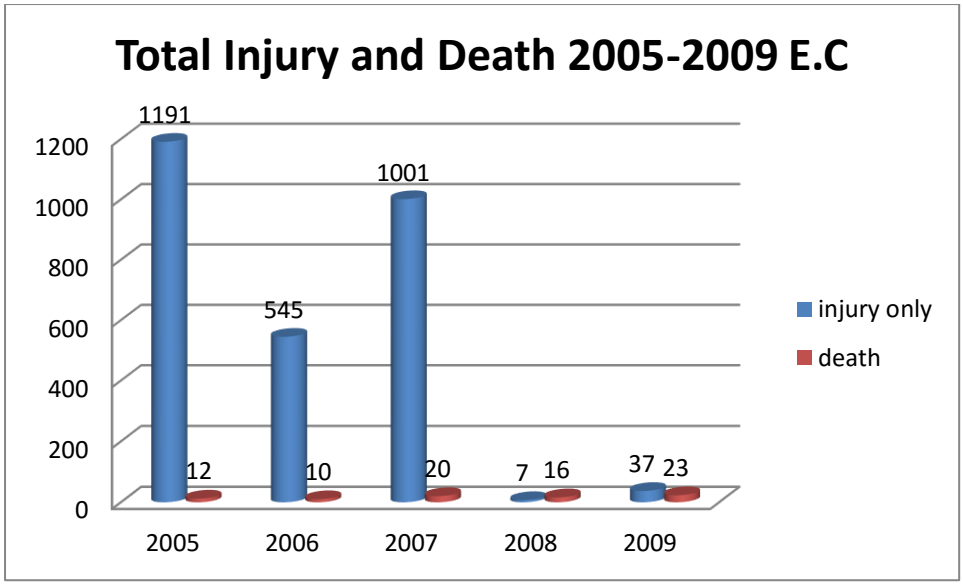

Figure 4: 9 Total Number of Injury and Death 2005 to 2009 E.C

Table 4: 5 Casualty of Accidents 2005 and 2006 (Source: Addis Ababa city of labor and social affairs bureau)

		Number of workers			Number of injury				
Year in E.C	**Nº of companies**	Male	Female	Total	Slight	Serious	Total	Death	Permitted days due to injury
2005	29	17804	3535	21339	853	338	1191	12	18099
2006	34	3188	1199	4387	142	403	545	10	14424

From the table above table 4.2, we see that the casualty of accidents in 2005 is greater than the casualty in 2006. High number of working days,18099 work days, also lost in 2005.

The above data is obtained from Addis Ababa city labor and social affairs bureau annual report of 2005 and 2006, however the report 2007 is different and prepared at this year 2009. So the accidents federally includes from 2005 to 2007 but the accident surveyed in 2008 and 2009 is only from Addis Ababa.

Figure 4.10 and 4.11 summarizes slight, serious and death accidents from 2002 to 2008 however the accident number 2005 to 2007 includes Amara, Tigray, Oromia, and SNNPP in addition to Addis Ababa city. Even though the data in 2002 and 2003 is the construction accident occurred only in Addis Ababa, excluding other regions. But the number of slight injury in 2002 and 2003 is high.

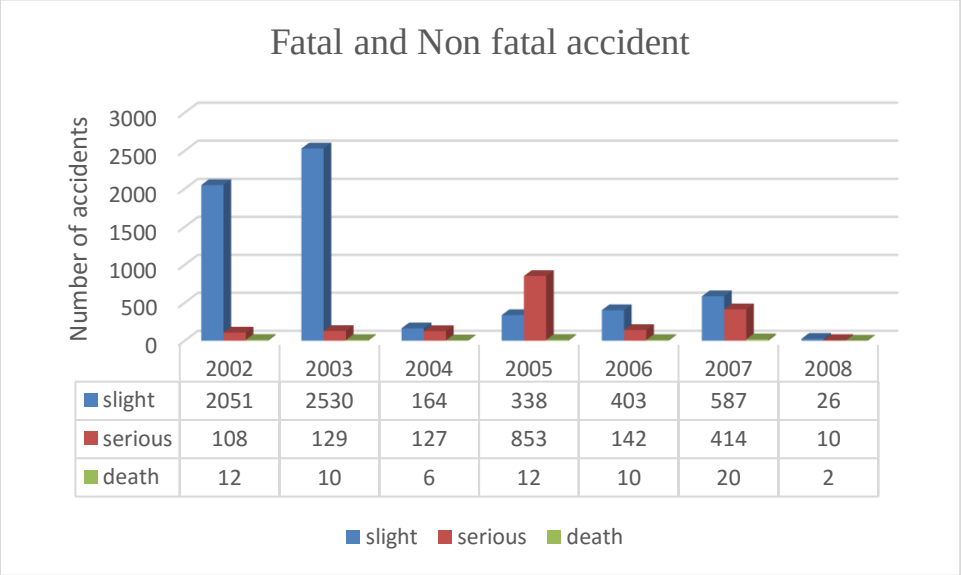

Figure 4: 10 Slight, Serious and Death accidents by number 2002 to 2008

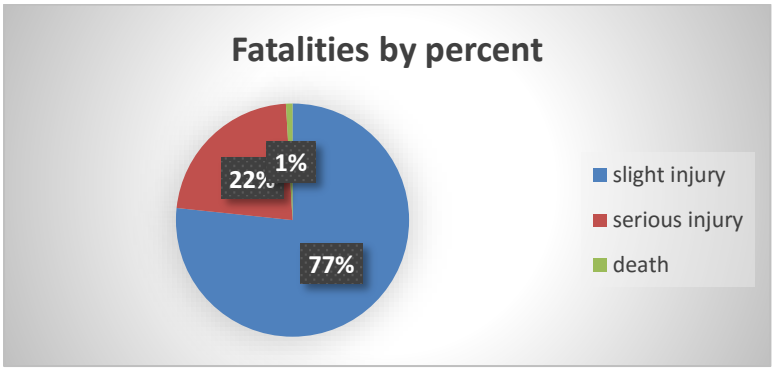

Figure 4: 11 Slight, Serious and Death Accidents from 2002-2008 by percent

4.7 Construction Site Accident by Injured Body Parts

In 2005 there are 183 HEENT injuries, 94 on eye, 25 on ear and 64 clearly not indicated and 1026 injuries bellow neck that means 466 injuries on upper body parts, 417injuries on middle body parts, 104 injuries on lower body parts and 39 unknown. Upper body parts and middle body parts have first and second rank in frequency of the injuries in 2005 E.C.

In 2006 out of the reported injuries there are 158 HEENT injuries 69 on eye, 19 on ears and 70 others. On upper body parts 139 injuries, 172 middle body parts injuries, 142 injuries on lower body parts and 373 injuries are not indicated. In 2006 E.C unknown or not indicated injuries and middle part of the body have 1st and 2nd rank respectively.

Table 4: 6 Number of accidents by injured body parts (Source: Addis Ababa city of labor and social affairs bureau)

		Year in Ethiopian Calendar		
Injured Body parts		2005	2006	2007
HEENT	Eye	94	69	2
	Ear	25	19	-
	Other-1	64	70	4
Upper Body parts		466	139	143
Middle Body parts		417	172	64
Lower Body parts		104	142	77
Other-2		39	373	4
Unspecified		-	-	727
Total		1209	984	1021

Rate of Fatal Injuries

In this topic it is calculated that the ratio of fatality only death with the number of laborers in Ethiopia construction industry. As we shown from the figure the highest rate of fatality is occurred on 2006.the second and the third had occurred on 2008 and 2007 respectively. While the number of accidents are greater in number in 2005 comparing with the reported accident and employment size we can conclude that the rate of fatal injuries in 2005 is less than the other years.

$$\text{Injury rate per 1000 Employees} = \frac{\text{No of occupational injury}}{\text{employment size}} X1000$$

$$\text{Injury rate per 1000 Workers} = \frac{\text{No of industrial injury}}{\text{Employment size}} X1000$$

Table 4: 7 Employment size and total occupational injury 2005 to 2009 E.C

year in E.C	Employment size	Total no of occupational injury	Rate of Injuries
2005	21339	1209	56.66
2006	4387	984	224.30
2007	3272	1021	312.04
2008	987	23	23.30
2009	1048	26	24.81

Figure 4: 12 Rate of Occupational injuries per 1000 workers 2005 to 2009 E.C

Table 4: 8 Employment size and rate of fatal accident per 1000 workers 2005 to 2009 E.C

Year in E.C	Employment size	No Of death	Rate of fatal accident per 1000 workers
2005	21339	12	0.56
2006	4387	10	2.28
2007	3272	20	6.11
2008	987	16	16.21
2009	1048	27	25.76

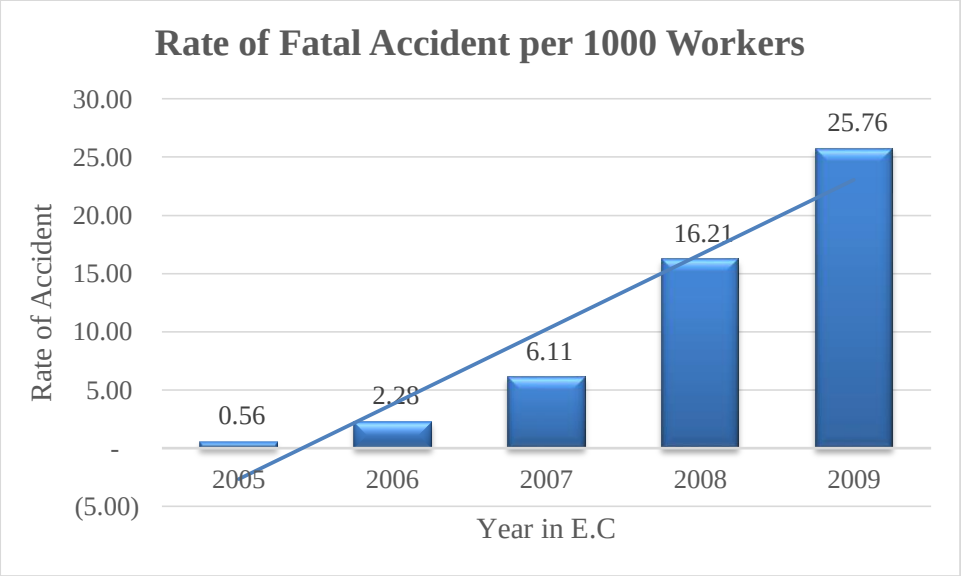

Figure 4: 13 Rate of Fatal Injuries per 1000 Employees 2005 to 2009 E.C

The number of construction sectors are increasing from year to year and due to increasing the construction sectors laborers also increase in number, as the number of constructions companies and the number of stakeholders increase the number of fatality rate also increase, the fatality rate is increasing from 2005 up to 2009 as see in figure 4.13, however this is not to mean that safety culture in the construction is decreasing. Safety climate in the industry improves from time to time, for example availability of personal protective equipment and safety training, however the researcher conclude that the safety culture and the number of construction stakeholders, employers and employees are increasing disproportionally.

Table 4:9, 4:10 & 4:11 shows a report of accidents, their causes and insurance payments obtained from three volunteer insurance companies in Addis Ababa for which formal requests were made by Addis Ababa bureau of labor and social affairs for their yearly insurance claim from construction companies.

Table 4: 9 Four years Insurance claims by construction companies from United Insurance Company

Year 2000 E.C

No	Types of accidents	Amount	Causes of accidents	Insurance payment	Reference
1.	Temporary disablement	17	-	209,032.65	Expense only for medical treatment
2.	Permanent disablement	42	-	49,190.89	Compensation for permanent disablement
3.	Death				
	Total	**59**	**258,223.54**		

Year 2001 E.C

No	Types of accidents	Amount	Causes of accidents	Insurance payment	Reference
1.	Temporary disablement	20	-	455,180.19	Expense only for medical treatment
2.	Permanent disablement	88	-	119,906.04	Compensation for permanent disablement
3.	Death	1		132,000.00	Compensation for death
	Total	**109**	**707,086.23**		

Year 2002 E.C

No	Types of accidents	Amount	Causes of accidents	Insurance payment	Reference
1.	Temporary disablement	22	-	323,332.72	Expense only for medical treatment
2.	Permanent disablement	58	-	74,399.64	Compensation for permanent disablement
3.	Death	6		478,000.00	Compensation for death
	Total	**86**		**875,732.36**	

Year 2003 E.C

No	Types of accidents	Amount	Causes of accidents	Insurance payment	Reference
1.	Temporary disablement	2	-	64,000.00	Expense only for medical treatment
2.	Permanent disablement	30	-	67,106.50	Compensation for permanent disablement
3.	Death	1		63,067.00	Compensation for death
	Total	**33**		**194,173.50**	

Table 4: 10 Two years Insurance claims by construction companies from Awash Insurance Company

Year 2002 E.C /Awash Insurance

No	Types of accidents	Amount	Causes of accidents	Insurance payment
1.	Temporary disablement	179	various-	44,297.70
2.	Permanent disablement	23	various-	94,323.45
3.	Death	3		118,950.00
	Total	**205**		**257,571.15**

Year 2003 E.C /Awash Insurance

No	Types of accidents	Amount	Causes of accidents	Insurance payment
1.	Temporary disablement	90	various-	112,962.35
2.	Permanent disablement	20	various-	112,069.36
3.	Death	2		78,000.00
	Total	**112**		**303,031.71**

Table 4: 11 Two years Insurance claims by construction companies from Nib Insurance Company

Year 2002 E.C

No	Types of accidents	Amount	Causes of accidents	Insurance payment	Reference
1.	Temporary disablement	1850	Falling, hand injuries ,hit by objects	450,343.50	Expense only for medical treatment
2.	Permanent disablement	27	Falling & hit by objects	128,226.00	Compensation for permanent disablement
3.	Death	3	Falling from height, heavy duty machineries and electrical accident	143,250.00	Compensation Paid for legal inheritors
	Total	**1880**		**721,819.50**	

Year 2003 E.C

No	Types of accidents	Amount	Causes of accidents	Insurance payment	Reference
1.	Temporary disablement	2438	Falling, hand injuries ,hit by objects	450,343.50	Expense only for medical treatment
2.	Permanent disablement	79	Falling & hit by objects	128,226.00	Compensation for permanent disablement
3.	Death	7	Falling from height, heavy duty machineries and electrical accident	143,250.00	Compensation Paid for legal inheritors
	Total	**2524**		**1,516,063.85**	

Note; Temporary disablement is nothing but when a person injured or loss part of his body or unable to work for a long time where as temporary disablement is when a person injured temporarily that can be recuperate with short time and treated with medical.

The Ministry of Labor and Social Affairs office and/or the respective labor offices in the cities/administrative regions should work together with the insurance companies for the proper listing of work-related accidents and diseases.

CHAPTER FIVE
CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

As a conclusion from the findings there is a little safety culture in Ethiopian construction industry.

The OSH practices in the construction companies are very poor. This indicates that OSH related Laws, rules and directives are not implemented in the construction industry. Negligence, lack of awareness and cost of PPE are the problems and the challenge of contractors in implementing OSH.

Most of employees on the construction sites have doing their work without PPE. Since the nature of construction work is very complex and uses heavy equipment's and materials around work place as a result among other sectors construction industry is the risky and accidents occur frequently.

As a summary to the research finding, most of the causes of the accident in building construction is falling from height. Falling from height is very frequently occur on the accident history of Ethiopia. As a result to the falling from height death and broking injuries happened to the laborers who fall from height is around 471, 301 due mishandling and 289 from falling objects workers suffer accidents which is in three years from 2005 to 2007, specially upper body parts are exposed to the injuries. Among these causes of accidents including hand tools, collisions, transportation and others 736 worker accident is abrasion, 397 punctured and 164 rupture. In 2005 there were 1191 non-fatal and 12 fatal accidents, in 2006, 545 non-fatal and 10 fatal, and in 2007 1001 non-fatal and 20 fatal accidents.in 2008 and in 2009 the fatal injury is greater which is in 2008, 7 non-fatal and 16 fatal and in 2009, 37 non-fatal and 23 fatal accidents. Most of these accidents happened on the beginning of the week, Monday and Tuesday.

5.2 RECOMMENDATION

- Employees should have trained safety related issues from qualified persons.
- Owners should include safety performance as a requirement when selecting contractors and sub-contractors.
- Supervisors should provide constant encouragement for workers on site to do their jobs safely
- All organization should be willing to improve their safety performance to make a fundamental change
- There should be good communication at sites about health and safety issue
- The construction companies should provide safety orientation for new employees
- First aid kit should be available and easily accessible with sufficient materials in it
- Supervisors should proactively monitor what is happening in the work group to have an early warning of emerging issues
- The existing laws, directives and regulations of the country regarding health and safety should be implemented by management of the company
- Safety should be seen as primary consideration in planning and allocating project resources
- There should be enough workers to carry out the required work safely, workloads should managed well and safely.
- Safety measures should be properly installed and maintained until the construction work is completed
- Further research could focus on developing safety practices and accidental reduction strategies

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Appendix

Questionnaire

My name is Selam Kassahun currently I am working for master's thesis in construction technology and management at Addis Ababa science and technology university, my thesis focus is on the facts and figures of statistical analysis of construction industry accident in Ethiopia, to achieve the objective I need health and safety related data. I am grateful in advance for your cooperation in completing the questionnaire. (The data collected will be used for academic purpose and it will be confidential)

General information

A. Code ----------

B. Age---------- Gender ☐ female ☐ male

C. Work position ☐ p. manager ☐ Site engineer ☐ Forman

D. Employment status ☐ definite period ☐ indefinite period

E. Educational background ☐ high school ☐ college diploma ☐ degree and above

F. How many years have you worked in the construction sector?----------

G. How many years have you worked in this construction project?----------

S/No		Strongly disagree		Disagree		Neutral		Agree		Strongly agree	
		Frequency	Percent	Frequency	Percent	Frequency	percent	Frequency	Percent	Frequency	percent
1	The project manager really cares about the health and safety of the people who work here										
2	First aid kit is available and easily accessible with sufficient materials in it										
3	The project manager sometimes turns a blind eye when health and safety procedures/ rules are broken										
4	There should be a strong policy or regulation for the implementation of safety and health by the government										

5	Supervisors proactively monitor what is happening in the work group to have an early warning of emerging issues										
6	There is sometimes pressure to put production before safety										
7	The company provides safety orientation for new employees										
8	The company provides adequate training to the work force to exceed safety standards										
9	The project management team is only interested in safety after occurring an accident										
10	There is good communication at sites about health and safety issues which could affect workers										
11	Workers at sites have high levels of job satisfaction										
12	At sites there are no barriers stopping us from working well with each other										
13	Open reporting of mistakes and errors encourages that could affect health and safety										
14	Safety performance indicators are used by managers to improve safety										
15	If an accident occurs, managers at sites do not blame workers but consider other organizational causes, such as communication and work design										
16	Workers in construction always given feedback about incidents that have occurred										
17	The laws, directives and regulation of the country regarding health and safety are known and implemented by management of the company										
18	A good record of safety performance does not stop managers from trying to identify safety problems										
19	The project management team considers safety when setting production speed and schedule										
20	Safety is a primary consideration in planning and allocating project resource										
21	The project management team ensures workers are provided with required safety equipment										
22	The company has a medical insurance for all workers										

23	There are enough workers to carry out the required work safely, workloads are well managed and reasonable										
24	Workers on this project are willing to report incidents										
25	Workers are usually satisfied with the follow up and measures taken after accidents have taken place										
26	when workers lose their working ability due to occupational accident, they are given compensation										
27	The managers and foremen are willing to ask for health and safety advice from workers who have hands on experience										
28	Managers provide constant encouragement to do the job safely										
29	The accidents occurred usually due to employees mistake										
30	The accidents occurred usually due to faulty procedure of work										